APPEAL NO. 2016-1013

United States Court Of Appeals For The Federal Circuit

COX COMMUNICATIONS, INC.; COXCOM, LLC; COX ARKANSAS TELCOM LLC; COX COMMUNICATIONS ARIZONA LLC; COX ARIZONA TELCOM LLC; COX CALIFORNIA TELCOM LLC; COX COMMUNICATIONS CALIFORNIA LLC; COX COLORADO TELCOM LLC; COX CONNECTICUT TELCOM LLC; COX DISTRICT OF COLUMBIA TELCOM LLC; COX FLORIDA TELCOM LP; COX COMMUNICATIONS GEORGIA LLC; COX GEORGIA TELCOM LLC; COX IOWA TELCOM LLC; COX IDAHO TELCOM LLC; COX COMMUNICATIONS KANSAS LLC; COX KANSAS TELCOM LLC; COX COMMUNICATIONS GULF COAST LLC; COX COMMUNICATIONS LOUISIANA LLC; COX LOUISIANA TELCOM LLC; COX MARYLAND TELCOM LLC; COX MISSOURI TELCOM LLC; COX NEBRASKA TELCOM LLC; COX COMMUNICATIONS OMAHA LLC; COX COMMUNICATIONS LAS VEGAS INC.; COX NEVADA TELCOM LLC; COX NORTH CAROLINA TELCOM LLC; COX OHIO TELCOM LLC; COX OKLAHOMA TELCOM LLC; COX RHODE ISLAND TELCOM LLC; COX COMMUNICATIONS HAMPTON ROADS, LLC; COX VIRGINIA TELCOM LLC,

Plaintiffs – Appellees,

v.

SPRINT COMMUNICATION COMPANY LP;
SPRINT SPECTRUM, L.P.; SPRINT SOLUTIONS, INC.,

Defendants – Appellants,

CISCO SYSTEMS, INC.,

Defendant.

ON APPEAL FROM THE
UNITED STATES DISTRICT COURT FOR THE DISTRICT OF DELAWARE IN
CASE NO. 1:12-CV-00487-SLR, JUDGE SUE L. ROBINSON.

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CERTIFICATE OF INTEREST

Counsel for Defendants-Appellants certifies the following:

1. The full name of every party or amicus represented by me is:

   Sprint Communications Company, L.P.; Sprint Spectrum, L.P.; Sprint Solutions, Inc.

2. The name of the real party in interest (if the party named in the caption is not the real party in interest) represented by me is:

   N/A

3. All parent corporations and any publicly held companies that own 10 percent or more of the stock of the party or amicus curiae represented by me are:

   SoftBank Group Corp.

4. The names of all law firms and the partners or associates that appeared for the party or amicus now represented by me in the trial court or agency or are expected to appear in this court are as follows:

   Shook, Hardy & Bacon, LLP (B. Trent Webb, Peter E. Strand, Robert H. Reckers, John D. Garretson, Ryan D. Dykal, Aaron E. Hankel, Ryan J. Schletzbaum, David Morehan, Jordan T. Bergsten, Lynn C. Herndon); Morris James LLP (Richard K. Hermann, Mary Matterer)

December 18, 2015
Date

/s/ B. Trent Webb
B. Trent Webb

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STATEMENT OF RELATED CASES

Pursuant to Federal Circuit Rule 47.5, Sprint provides as follows:

(a) No previous appeal has been taken in this action;

(b) There are three cases pending in the District of Kansas involving these same patents: *Sprint Communications Co., L.P., v. Comcast Cable Communications, LLC, et al.*, Case No. 11-2684-JWL (D. Kan.); *Sprint Communications Co., L.P. v. Cable One, Inc.*, Case No. 11-2685-JWL (D. Kan.); and *Sprint Communications Co., L.P. v. Time Warner Cable Inc., et al.*, Case No. 11-2686-JWL (D. Kan.) (hereinafter "the Current Kansas Cases"); and

(c) Cisco Systems, Inc. has also filed a declaratory judgment action in the District of Delaware involving the same patents at issue in this appeal: *Cisco Systems, Inc. v. Sprint Communications Co. L.P.*, Case No. 1:15-cv-00431 SLR (D. Del.).

In the Current Kansas Cases, the District of Kansas considered the same question presented here and found that the term "processing system" was ***not*** indefinite. (A835-A839) The Current Kansas Cases are stayed pending this appeal.

STATEMENT OF JURISDICTION

The District Court had jurisdiction under 28 U.S.C. §§ 2201, 2202, 1331, and 1338 and entered a final judgment under FED. R. CIV. P. 54(b) on September 3, 2015. (A1-A2) This appeal was noticed on October 1, 2015 and is timely. (A1521-A1522) *See also* 28 U.S.C. § 2107(a); FED. R. APP. P. 4. This Court has jurisdiction under 28 U.S.C. § 1295(a)(1).

STATEMENT OF THE ISSUE

Did the District Court err in holding the claims of the six asserted patents indefinite where: (a) these method claims recite the specific steps performed by the "processing system"; (b) the specification lists existing devices that could serve as a "processing system" and how to situate and operate those devices in a telephone network; and (c) Sprint's expert provided uncontroverted testimony supported by contemporary publications that, in the context of the claims, a skilled artisan would understand the scope of "processing system" with reasonable certainty?

STATEMENT OF THE CASE

A. Preliminary Statement

Sprint appeals the District Court's judgment that six Sprint patents covering methods for setting up telephone calls between different networks are invalid. Cox Communications, Inc. and related entities ("Cox") filed a declaratory judgment suit against Sprint Communications Co. L.P. ("Sprint") in the United States District Court for the District of Delaware on April 16, 2012. (A82; A178-A215) Cox moved for partial summary judgment of invalidity as to six of Sprint's patents. (A702-A727) Those patents' asserted claims all contain the term "processing system." The District Court held this term to be indefinite, rendering the claims invalid under 35 U.S.C. § 112(b). (A10-A20) The District Court certified the partial summary judgment order as final pursuant to Federal Rule of Civil Procedure 54(b) on September 3, 2015. (A1-A2; A3-A9) Sprint filed this timely appeal of the indefiniteness decision. (A1521-A1522)

B. Procedural History

On December 19, 2011, Sprint filed suit against Cox in the United States District Court for the District of Kansas. (*Sprint Communications Co. L.P. v. Cox Communications, Inc. et al.*, Case No. 11-cv-2683 JAR.GLR (D. Kan.) ("Kansas Action")). In the lawsuit, Sprint alleged infringement of twelve United States patents relating to voice-over-packet ("VOP") technology. (A192-A193) On the

same day, Sprint also filed suit against Comcast, Cable One, and Time Warner Cable in the District of Kansas for infringement of the same twelve patents. (A1499; *Sprint Communications Co. L.P. v. Comcast Cable Communications, LLC et al.*, Case No. 11-cv-2684 JWL/JPO (D. Kan.) ("*Comcast*"); *Sprint Communications Co. L.P. v. Cable One, Inc.*, Case No. 11-cv-2685 JWL/JPO (D. Kan.) ("*Cable One*"); and *Sprint Communications Co. L.P. v. Time Warner Inc. et al.*, Case No. 11-cv-2686 JWL/JPO (D. Kan.) ("*TWC*") (collectively, "the Current Kansas Cases")).

Cox filed a declaratory judgment action against Sprint in the United States District Court for the District of Delaware on April 16, 2012. (*Cox Communications, Inc. et al. v. Sprint Communications Co. L.P. et al.*, Case No. 1:12-cv-00487 SLR (D. Del.) ("Underlying Action")). (A178-A215) In the Underlying Action, Cox sought a declaratory judgment of invalidity and non-infringement of all twelve patents asserted by Sprint in the Kansas Action. (A178-A215) Two days later, Cox moved to transfer the Kansas Action to the District of Delaware. On September 14, 2012, Judge Julie A. Robinson of the District of Kansas granted Cox's motion and this matter was transferred to Judge Sue L. Robinson in the District of Delaware. Sprint subsequently counterclaimed in the Underlying Action for infringement of the twelve asserted patents along with several others patents that are not at issue in this appeal. (A612-A645)

Sprint's three co-pending lawsuits in the District of Kansas (*Comcast, Cable One, and TWC*) were consolidated for discovery purposes before Judge John W. Lungstrum. In the consolidated Kansas cases, Judge Lungstrum construed terms in each of the six patents subject to this appeal, including the "processing system" term. (A822-A914) *See Sprint Commnc's Co. L.P. v. Comcast Cable Commnc's LLC,* et al., 2014 WL 5089402, at *6 (D. Kan. Oct. 9, 2014) (hereinafter, "Comcast *Markman*").

Subsequent to Judge Lungstrum's ruling in Kansas, Cox filed a motion for partial summary judgment in the Underlying Action, arguing that "processing system" is indefinite as used in U.S. Patent Nos. 6,452,932 ("the '932 Patent"), 6,463,052 ("the '052 Patent"), 6,633,561 ("the '3,561 Patent"), 7,286,561 ("the '6,561 Patent"), 6,298,064 ("the '064 Patent"), and 6,473,429 ("the '429 Patent"). (A134, A702-A727) Sprint opposed the motion and provided two declarations from an expert in the relevant art setting out disputed issues of material fact warranting denial of summary judgment. (A137; A927-A952; A953-A954; A955-A992; A993-A1009) The same declarations were previously considered by Judge Lungstrum in the consolidated Kansas cases. (A838) Cox replied, and attached the expert declaration of Dr. Leonard J. Forys, which was also considered by Judge Lungstrum in the consolidated Kansas cases. (A139; A1362-A1376; A1377-A1391) Sprint filed a sur-reply to Cox's motion for partial summary judgment on

April 2, 2015. (A1392-1403) Judge Robinson heard oral arguments on Cox's motion for partial summary judgment and subsequently granted Cox's motion, finding the term "processing system" indefinite and therefore invalid. (A1404-A1468; A10-A20)

Cox then asked Judge Robinson to certify her May 15, 2015 Partial Summary Judgment Order as final pursuant to Federal Rule of Civil Procedure 54(b). (A1497) Judge Robinson granted Cox's request over Sprint's objection, and final judgment of invalidity for the '932, '052, '3,561, '6,561, '064, and '429 Patents was entered on September 3, 2015. (A3-A9; A1-A2) Sprint filed a timely notice of appeal on October 1, 2015. (A1521-A1522)

STATEMENT OF FACTS

A. The Parties

Sprint is a telecommunications company and holds scores of patents relating to using packet networks (such as the Internet) for digital telephone communications, including the patents that are the subject of this appeal. (A827) Cox Communications Inc. is the direct or indirect parent company of numerous Cox Entities that provide digital telephone services over the Internet in various markets throughout the United States. (A180-A186)

B. Circuit-Switched Networks

Connecting telephone calls using dedicated circuits has existed in one form or another since the late 1800s. (A961-A962) Such telephone networks are called circuit-switched networks. The Public Switched Telephone Network, or PSTN, is the most famous circuit-switched network, and functions by establishing a dedicated circuit from the calling party to the called party. (A962)

Setting up a telephone call in a circuit-switched network involves establishing a dedicated circuit from the calling party to the called party—sometimes coordinating numerous switches in various local and long-distance exchanges to complete the call. (A962-A963) Circuits are typically set up using "signaling," which involves transferring of call setup information among the various network components. (A963; A297, '3,561 Patent at 2:5-28; A414, '064 Patent at 17:35 to 18:6)

C. Packet-Switched Networks

Packet-switched networks, such as the Internet, represent another way to communicate across a network. (A964) Rather than establish a dedicated circuit, packet networks work by routing each packet of data individually according to the address information included in the packets themselves. (A964-A965)

By the mid-1990s, it was clear that packet-switched networks possessed numerous advantages over circuit-switched networks. (A965; A297, '3,561 Patent

at 2:28-37) As a consequence, telephone companies were actively researching how the two disparate types of networks could be connected. (A966)

D. Sprint's Research and the Joe Christie Inventions

The six Sprint Patents at issue in this appeal claim methods for operating a telecommunications network linking circuit-switched and packet-switched networks. (A965-A967; A967-A978; A297-A298, '3,561 Patent at 2:54-3:20, 3:34-4:36)

In 1993, a Sprint engineer named Joe Christie invented a pioneering telecommunications system that dramatically changed the industry. (A935) Specifically, Mr. Christie and his team invented a way to use a packet-switched network to transport telephone calls to and from the existing circuit-switched PSTN. (A935) This Sprint team developed and patented methods of using network components and network architectures to allow the PSTN to "talk" to packet networks and vice versa. (A935; A297-A298, '3,561 Patent at 2:54-3:20, 3:34-4:36) The same Sprint team developed methods of using components and telephone network architectures to set up and route telephone calls across these disparate networks in a seamless and transparent manner. (A935; A297-A298, '3,561 Patent at 2:54-3:20, 3:34-4:36; A733-A737)

Based on this work, Mr. Christie and his Sprint team were awarded more than 100 patents, which were all assigned to Sprint. (A966) In this appeal, two

families of Sprint's patents are at-issue: The Call Control Patents and the Broadband System Patents.

E. The Call Control Patents

The '932, '052, '3,561, and '6,561 Patents (hereinafter, "the Call Control Patents") share a common specification, and each claims priority to an application filed on May 5, 1994. (A337-A359, '932 Patent; A309-A336, '052 Patent; A285-A308, '3,561 Patent; A568-A590, '6,561 Patent)[1] The Call Control Patents describe methods, systems, and devices for telecommunication control of calls to and from the packet-switched communication system. (A967; A284, '3,561 Patent at Abstract; A298-A303, '3,561 Patent at 4:13-25, 8:35-48, 13:3-27; A406-A407, '064 Patent at 2:65 to 3:4)[2] Notably for purposes of this appeal, the Call Control Patents disclose an exemplary "processing system," explaining:

> ***The CCP is a processing system****, and as such, those skilled in the art are aware that such systems can be housed in a single device or distributed among several devices. Additionally, multiple devices with overlapping capabilities might be desired for purposes of redundancy. The present invention encompasses these variations. One such operational system would be multiple pairs of CCPs located regionally within a telecommunications system. Each machine would be equally capable of communication control.*

[1] The asserted independent claims from the Call Control Patents invalidated in the Underlying Action are claim 1 of the '932 Patent, claim 1 of the '052 Patent, claims 1 and 24 of the '3,561 Patent, and claim 11 of the '6,561 Patent. (A708)

[2] For brevity, Sprint cites to the '3,561 Patent specification for the Call Control Patents. (A283-A308)

(A303, '3,561 Patent at 13:41-50) (emphasis added). The Call Control Patent specification even identifies existing devices that qualify as "processing systems":

> ***One example of a CCP device would be a Tandem CLX machine configured in accord with this disclosure of the present invention.***

(A303, '3,561 Patent at 13:48-52) (emphasis added).

F. The Broadband System Patents[3]

The '064 and '429 Patents (hereinafter, "the Broadband System Patents") share a common specification and each claims priority to an application filed on September 8, 1995. (A391-A421, '064 Patent; A360-A390, '429 Patent)[4] The Broadband System Patents relate to inventions covering a broadband communication system. (A975; A395; A403-A404; A406-A407, '064 Patent at 2:65 to 3:4) In particular, the Broadband System Patents focus on an interface between the narrowband (circuit-switched) and broadband (packet-switched)

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[3] The Broadband System Patents incorporate the disclosures of the Call Control specifications by reference, including, in particular, a parent Call Control U.S. Patent No. 5,825,780 (application number 08/568,551), which was a continuation of the May 1994 application number 08/238,605. (A355, '429 Patent at 1:12-20) Thus, the Call Control Patent disclosures discussed above apply equally to the Broadband System Patents. *See Advanced Display Systems, Inc. v. Kent State University*, 212 F.3d 1272, 1282 (Fed. Cir. 2000) ("Incorporation by reference provides a method for integrating material from various documents into a host document."). For brevity, however, Sprint does not separately repeat these incorporated disclosures for the Broadband System Patents.

[4] The asserted independent claims from the Broadband System Patents invalidated in the Underlying Action are claim 1 of the '064 Patent and claim 1 of the '429 Patent. (A708-A709)

networks. (A975; A410-A415; A403-A404) The Broadband System Patents provide extensive disclosure directed to an exemplary processing system, referred to as a Call Control Manager (CCM). (A975; A408-A409, '064 Patent at 6:23-7:63; A414-A415, '064 Patent at 17:35 to 19:55; A405)[5] The CCM includes the functionality of a signaling processor. (A976; A407, '064 Patent at 4:26-33; A414-A415, '064 Patent at 17:35 to 19:55; A405) It can take signaling information corresponding to narrowband networks (such as the dialed number) and translate them into signaling traffic that selects connections to a broadband network. (A976; A408, '064 Patent at 6:54-59)

As is discussed in the Broadband System Patents, the CCM may be composed of multiple physical components. (A976-A977; A411, '064 Patent at 12:51-56) As illustrated by Figure 6, the processing system may include: message transfer parts (MTP), Ethernet interfaces, platform handlers, message handlers, and data handlers. (A411, '064 Patent at 11:5-59)

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[5] For brevity, Sprint cites to the '064 Patent specification for the Broadband System Patents. (A391-A421)

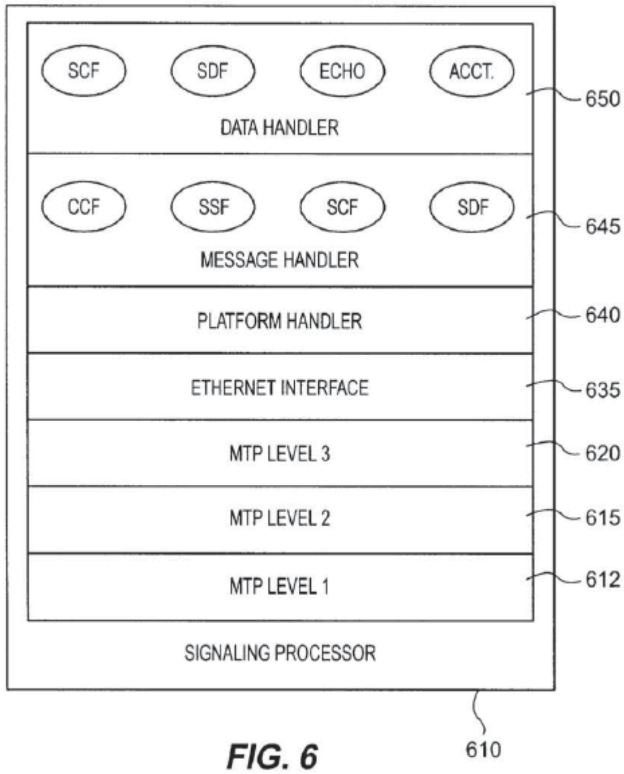

FIG. 6

Notably, the Broadband System Patent specification discloses existing devices as exemplary processing systems:

> Those skilled in the art are aware of various hardware components which can support the requirements of the invention. ***For example, the platform handler, message handler, and data handler could each reside on a separate SPARC station 20***.

(A411, '064 Patent at 12:52-56.)

G. Dr. Stephen Wicker's Opinions

Dr. Stephen B. Wicker is a telecommunications expert retained by Sprint. (A955-A1009) Dr. Wicker is a Professor of Electrical and Computer Engineering at Cornell University and has published extensively regarding communication systems and information networks. (A958-960) In connection with this case, Dr.

Wicker evaluated the Call Control Patents and the Broadband System Patents and concluded that a person of ordinary skill in the art at the time of filing for the Sprint patents would have a bachelor's degree in electrical engineering (or similar course of studies) and three or more years of experience with telephone switching systems. (A986) Dr. Wicker executed two declarations that were submitted as evidence in both the Underlying Action and in the consolidated Kansas cases. (A955-A992; A993-A1009)

Dr. Wicker evaluated the "processing system" term that is the subject of this appeal. First, Dr. Wicker explained that, in light of the specifications and claims, "processing system" had an understood meaning within the telecommunications industry by those of ordinary skill in the art at the time of the invention. (A989) For example, Dr. Wicker identified portions of the '052 Patent specification (a Call Control Patent) that discuss the meaning of "processing system." (A989) Similarly, Dr. Wicker identified two patents cited by the '429 Patent and '064 Patent that use this term. (A989) Consistent with this intrinsic evidence, Dr. Wicker opined that the term "processing system" was "known in the art at the time of the invention and refers to a system that processes signaling to assist in call control." (A989) In a second declaration, Dr. Wicker opined that "[b]ased on my review of the Sprint Asserted Patents, the prosecution history of the Sprint Asserted Patents, and in light of the *Nautilus* decision, it is my opinion that a

person possessing ordinary skill in the art would understand the scope and meaning of the claims in the Sprint Asserted Patents with reasonable certainty." (A997-A998)

Dr. Wicker also performed a search of patent publications containing claims that use the term "processing system" published between January 1, 1990, and December 31, 1999. (A998) Dr. Wicker explained that numerous patents use the phrase "processing system" in accordance with its ordinary meaning, including multiple patents considered by the Patent Office during prosecution. (A999-A1000) In particular, U.S. Patent No. 4,720,850, issued to AT&T in 1988, refers to a "call processing system design" and references other patents with titles containing "processing system." (A999) Dr. Wicker also identified U.S. Patent No. 6,016,343, filed by Link Corporation in 1996, as another example of a contemporaneous patent that described a "call processing system." (A999) Consistent with these patents, his patent publication search, and the intrinsic evidence, Dr. Wicker concluded that "'processing system' had a well-known meaning to person having ordinary skill in the art at the time of the Sprint inventions, and therefore, a person of ordinary skill in the art would understand the scope of this phrase as used in the Asserted Sprint Patents with reasonable certainty." (A999-A1000)

H. Sprint's Enforcement Efforts

Sprint has enforced the asserted patents, and the term "processing system" has been construed in prior lawsuits.

In *Sprint Commc'ns. Co. L.P. v. Vonage Holdings Corp., et al., Voiceglo Holdings, Inc., and theglobe.com, Inc.*, Case No. 05-cv-02433 (D. Kan.), the claims of the patents at-issue on appeal were construed by the District Court for the District of Kansas. *See Sprint Comm. Co. L.P. v. Vonage Holdings Corp.*, 500 F. Supp. 2d 1290 (D. Kan. 2007) ("*Vonage* I"); *Sprint Comm. Co. L.P. v. Vonage Holdings Corp.*, 518 F. Supp. 2d 1306 (D. Kan. 2007) ("*Vonage* II"). After a three-week jury trial in 2007 against Vonage, all asserted claims were found not invalid and willfully infringed. (A621-A622)

The "processing system" claims of the patents at-issue in this appeal were also construed by the District of Kansas in *Sprint Commc'ns. Co. L.P. v. Big River Tel. Co., LLC*, 2009 WL 1992537 (D. Kan. July 8, 2009).

In December 2011, Sprint sued to enforce the same patents at issue here in suits against cable operators who provided telephone services in a manner that infringes Sprint's patented technology: *Sprint Communications Co. L.P. v. Cox Communications, Inc. et al.*, Case No. 11-cv-2683 (D. Kan.); *Sprint Communications Co. L.P. v. Comcast Cable Communications, LLC et al.*, Case No. 11-cv-2684 JWL/JPO (D. Kan.); *Sprint Communications Co. L.P. v. Cable One,*

Inc., Case No. 11-cv-2685 (D. Kan.); and *Sprint Communications Co. L.P. v. Time Warner Inc. et al.*, Case No. 11-cv-2686 (D. Kan.) (hereinafter, the "Current Kansas Cases").

In the Current Kansas Cases, the District of Kansas construed the same claims and, importantly, considered the same indefiniteness issue presented here. (A823-A914) After examining the same evidence presented to Judge Robinson in the Underlying Action, Judge Lungstrum in the District of Kansas found that the term "processing system" was ***not*** indefinite in light of *Nautilus*. (A832-A841); *see also* Comcast *Markman*, 2014 WL 5089402, *6. The Current Kansas Cases are now stayed pending this appeal.

I. Judge Lungstrum's Claim Construction Order

During claim construction in the Current Kansas Cases, the defendants, like Cox here, argued that the term "processing system" in Sprint's asserted patents was indefinite. (A832-A833) The parties submitted briefs to Judge Lungstrum after the Court's decision in *Nautilus, Inc. v. Biosig Instruments, Inc.*, 134 S. Ct. 2120 (2014), including expert declarations addressing the meaning of the "processing system" term. (A835-A839) On October 9, 2014, Judge Lungstrum issued a claim construction order in which he summarized defendants' indefiniteness argument:

> *Essentially, defendants argue that "processing system" is indefinite because it merely defines that structure by reference to its functions—that is, by reference to what it does and not to what it is. Defendants note that the patent does not disclose the programming or algorithm for the processing system. Defendants have not cited to any authority (other than cases involving Section 112(f), which does not apply here), however, that would support the argument that such definition by functional limitation renders a claim indefinite.*

(A837; Comcast *Markman*, 2014 WL 5089402, at **6-8)

Judge Lungstrum further found that *Microprocessor Enhancement Corp. v. Texas Instruments Inc.*, 520 F.3d 1367 (Fed. Cir. 2008) did "not support defendants' argument" because that case involved "an ambiguity about whether an apparatus or a method was claimed in the patent, and it found that a claim that was clearly a method claim was not indefinite." (A837 at n.3) "Similarly, in the present case defendants do not dispute that the claims at issue are method claims." (A837 at n.3) Judge Lungstrum then found the "claim is limited by the functions that must be performed by the processing system, and, again, defendants have not cited any authority to suggest that such a claim is inherently indefinite. Indeed, method claims are clearly permissible." (A837)

Judge Lungstrum also evaluated the same expert declarations submitted in the Underlying Action to determine if the term "processing system" would have been understood by one skilled in the relevant art. (A838) He acknowledged that Sprint's expert, Dr. Wicker, opined that "processing system" would have been understood in the telecommunications context to mean "a system that processes

signaling to assist in call control," and that Dr. Wicker identified various patents that used the term in this field. (A838) Defendants' expert conceded that "the phrase must refer to some kind of computer to perform the tasks described in the patent." (A838) And while the patents cited by Sprint's expert had different limitations, "those differences do not undermine the basic idea that the term 'processing system,' by itself, would refer to a system of processing signals in specified ways." (A838)

Ultimately, Judge Lungstrum held that defendants in the consolidated Kansas cases failed to show, by clear and convincing evidence, that claims containing the term "processing system" are invalid as indefinite. (A838-A839) Instead, "'[p]rocessing system' has an ordinary meaning that may easily be understood, and the claims provide notice that such a system may infringe if it performs certain functions as set forth in those claims." (A838-A839) "Thus, the public has been given reasonable notice of what has been claimed—and therefore, of what has not been claimed." (A839)

SUMMARY OF ARGUMENT

Sprint's use of the term "processing system" within its method claims defines the scope of Sprint's invention with reasonable certainty. The asserted claims cover methods for setting up telephone calls, and the "processing system" is claimed as receiving, processing, and transmitting signaling to perform its role in the call setup process. By the time of Sprint's invention, "processing systems" for handling call signaling to set up telephone calls had been in use for decades, and the patents' specifications provide extensive discussion of the claimed telecommunications "processing system," even specifically identifying a "Tandem CLX" or a "SPARC station 20" as well-known devices qualifying as processing systems. (A303, 3,561 Patent at 13:50-52; A411, '064 Patent at 12:52-56) In light of the context provided by the claims, the specifications, and other evidence, the claimed methods are certain in scope and thus definite.

The District Court nonetheless found "processing system" indefinite due to insufficient disclosure of physical structures bounding this claim element. In so doing, the District Court disregarded intrinsic evidence, noting that the physical structures associated with a processing system were only "functionally described by the claims and in the specifications" and thus do "not pass muster under *Nautilus*." (A18-A19) Contrary to the District Court's sole focus on physical structures, the definiteness inquiry asks whether "a patent's claims, viewed in light

of the specification and prosecution history, inform those skilled in the art about the scope of the invention with reasonable certainty." *Nautilus II*, 134 S. Ct. at 2129. The District Court failed to properly apply this analysis.

Indeed, this Court has made clear that, even for apparatus claims, the "recitation of . . . function" is "highly relevant to ascertaining the boundaries" of a claim term. *Biosig Instruments, Inc. v. Nautilus, Inc.*, 783 F.3d 1374, 1383 (Fed. Cir. 2015) ("*Nautilus III*"). In *Nautilus III,* for instance, this Court relied on context in the claims and specification to overrule a finding that "spaced relationship" was indefinite. There, this Court agreed with the district court that the specification "does not specifically define 'spaced relationship' with actual parameters, e.g., that the space between the live and common electrodes is one inch," but nonetheless concluded that the "claim language, specification, and figures" were "telling and provide sufficient clarity to skilled artisans as to the bounds of the disputed term." *Nautilus III*, 783 F.3d. at 1382-83. The District Court made a similar error in this case, focusing solely on structural bounds. This is particularly inappropriate here, where the parties agree that the claims are not drafted in means-plus-function format and are method claims. (A20 at n.9)

Finally, even if the District Court's novel "structural limitation" focus were proper, the claims and specifications provide substantial disclosure of both the functional and structural characteristics of the "processing system." Further,

contemporaneous patents and expert testimony confirms that "processing system" was a commonly used term in the telecommunication field at the time of Sprint's invention and that "processing system" has long had an accepted meaning in that field that matches Sprint's use of this terminology in its patents. In light of the intrinsic and extrinsic evidence, the scope of "processing system" is reasonably certain, and the District Court's finding of indefiniteness should be reversed.

ARGUMENT

I. STANDARD OF REVIEW

This Court reviews a district court's finding of indefiniteness *de novo*. *Interval Licensing LLC v. AOL, Inc.*, 766 F.3d 1364, 1370 (Fed. Cir. 2014). A claim is invalid for indefiniteness under 35 U.S.C. § 112(b) if its language, when read in light of the specification and prosecution history, fails to inform skilled artisans about the scope of the invention with reasonable certainty. *Nautilus II*, 134 S. Ct. 2120, 2129.

II. THE ASSERTED CLAIMS ARE DEFINITE

In the District Court for the District of Delaware, Judge Robinson concluded that the claimed "processing systems" recited by Sprint's patents are "structural limitations" that are only "functionally described by the claims and in the specification" and thus do not "pass muster under *Nautilus* as a person of ordinary skill is not provided with the bounds of the claimed invention." (A18-A20) In so holding, the District Court erred in its application of the *Nautilus* standard and disregarded important evidence establishing definiteness.

A. The Scope of "Processing System" is Reasonably Certain from the Context of the Claims.

The District Court erred in the first instance by disregarding the important context afforded "processing system" by the claims in which that term appears. The patent statute requires that each claim, as a whole, "particularly point[s] out

and distinctly claim[s] the subject matter which the inventor or a joint inventor regards as the invention." 35 U.S.C. § 112. Accordingly, the "definiteness inquiry focuses on whether those skilled in the art would understand the scope of the ***claim*** when the claim is read in light of the rest of the specification." *Energizer Holdings, Inc. v. Int'l Trade Comm'n*, 435 F.3d 1366, 1370 (Fed. Cir. 2006) (emphasis added, internal quotes omitted); *see also Ethicon Endo-Surgery, Inc. v. Covidien, Inc.*, 796 F.3d 1312, 1319 (Fed. Cir. 2015) (reversing indefiniteness on an apparatus claim, noting that "in the context of the dispute here" there was "no requirement for the specification to identify a particular measurement technique" for pressure, so long as "one skilled in the art [was] able to understand *which* pressures are relevant to the claims and *how* those pressures can be measured") (emphasis in original). "If there is a discernable plain and ordinary meaning of the claim language, then this meaning usually defines the scope of the claims unless the patentee has explicitly disclaimed or clearly disavowed this meaning in the specification or prosecution history." *Housey Pharm., Inc. v. Astrazeneca UK Ltd.*, 366 F.3d 1348, 1352 (Fed. Cir. 2004).

Consistent with this authority, this Court recently concluded that the term "spaced relationship" was definite within the context of the apparatus claim where it appeared, noting that the surrounding "recitation of . . . function" in that

claim was "highly relevant to ascertaining the boundaries of the 'spaced relationship.'" *Nautilus III*, 783 F.3d 1374, 1383. Despite this guidance, the District Court in this case found that the claim term "processing system" fails to provide "objective boundaries" to "determine the scope of the invention." (A20) In reaching this result, the District Court disregarded the recitation of function by the claims themselves, suggesting that the context provided by the claims was irrelevant for only "functionally" describing "the physical structures for 'processing system.'" (A18) But the disregarded claim context in Sprint's patents, as in *Nautilus III*, is "highly relevant to ascertaining the boundaries" of the processing system.

The asserted claims in this case recite method steps for setting up telephone calls, and clearly recite the role of a "processing system" in that method. Claim 1 of the '932 patent, for instance, recites a method for handling a telephone call:

> [1] A method for handling a call having a first message and communications, the method comprising:
>
> [1a] receiving and processing the first message in a ***processing system*** external to narrowband switches to select one of the narrowband switches;
>
> [1b] generating a second message in the ***processing system*** based on the selected narrowband switch and transmitting the second message from the ***processing system***; and

> [1c] receiving the second message and the communications in an asynchronous communication system and transferring the communications to the selected narrowband switch in response to the second message.

(A358, U.S. Patent No. 6,452,932 at 22:11-23) (emphasis added))[6]

As this example illustrates, the scope of "processing system" is bounded by the function it performs in these claims. In exemplary claim 1 of the '932 patent, the "processing system" assists in the performance of the claimed method for setting up a telephone call. For instance, the claimed method may be used to set up a call from a calling party on a broadband network (such as the Internet) to a called party on a narrowband network (such as the Public Switched Telephone Network, or "PSTN"). In this example, signaling messages are received from the calling party and processed in the "processing system." The "processing system" then generates a further signaling message identifying a switch on the narrowband network that will handle this call. There is nothing vague, subjective, or uncertain about the scope of the "processing system" in this context, and those skilled in the

[6] Like the '932 Patent claims, other invalidated patents all recite a litany of structural and functional features for the claimed "processing systems," rendering the meaning of these claims certain to those having ordinary skill in the art. (A732-A737 (copies of other invalidated claims)) For example, claim 1 of the '052 Patent recites that the claimed "processing system" is used to process calls over "a packet communication system" where the call will at some point exit the packet system into a different system (through a "network element to provide egress . . . from the packet communication system." (A732) As this example illustrates, the claims specify specific structural and functional features of the claimed "processing system." *Id.*

art would have recognized that the claimed "processing system" is, as the claims themselves require, ***a system that processes signaling to assist in call control***. (A999-A1000; A967-A978 (discussing disclosed "processing systems"))

Indeed, Cox admits that "we know what [the processing system] does." (A719) This is dispositive of the definiteness inquiry, especially in the context of this easily understood terminology in a method claim, where "certain things should be done with certain substances, and in a certain order; but the tools to be used in doing this may be of secondary consequence[.]" *Diamond v. Diehr*, 450 U.S. 175, 183 (1981) (quoting *Cochrane v. Deener*, 94 U.S. 780, 787-88 (1877)).

Notably, the District of Kansas, in the Current Kansas Cases, applied this Court's guidance to find that these very claims are definite. The Kansas court correctly found that the term "processing system" is limited in scope according to the functions it must perform:

> *[T]he claim is limited by the functions that must be performed by the processing system, and, again, defendants have not cited any authority to suggest that such a claim is inherently indefinite. Indeed, method claims are clearly permissible.*

See A837; Comcast *Markman*, 2014 WL 5089402, *6. The court concluded that "the context of the claims makes clear the different features and functions of the processing system that are actually claimed in the patents." *See* A837; Comcast *Markman*, 2014 WL 5089402, *6. Should this Court affirm the District of Delaware, it will overrule this straightforward and proper analysis from the District

of Kansas. *See Key Pharm. v. Hercon Lab. Corp.*, 161 F.3d 709, 716 (Fed. Cir. 1998) (noting "the national *stare decisis* effect that this court's decisions on claim construction have").

Sprint respectfully submits that the District of Kansas' analysis was correct and that the District of Delaware's failure to consider the claims' context led it to an erroneous conclusion regarding definiteness.

B. The Specifications Confirm the Scope of "Processing System."

The District Court also erred in disregarding the relevant teachings of the specifications, wrongly suggesting that the specifications provide only "functional[]" descriptions of the "processing system" that "do not pass muster under *Nautilus* . . . ." (A18-A20) In reality, the specifications provide ample detail that is more than sufficient to support the definiteness of the claimed "processing system," describing all relevant aspects of this claim element.

This Court has reversed findings of indefiniteness where a district court did not fully appreciate the context provided by the specification. For example, in *Young v. Lumenis, Inc.*, this Court reversed a finding that the claim term "near" was indefinite, and found a sufficiently clear meaning for the term "based on the several descriptions in the specification" and based on a patent figure that "provides a standard for measuring the meaning of the term 'near.'" 492 F.3d 1336, 1346 (Fed. Cir. 2007).

Likewise, in *Nautilus III* this Court relied on context in the specification to overrule a finding that "spaced relationship" was indefinite. There, this Court agreed with the district court that the specification "does not specifically define 'spaced relationship' with actual parameters, e.g., that the space between the live and common electrodes is one inch," but nonetheless concluded that the "claim language, specification, and figures" were "telling and provide sufficient clarity to skilled artisans as to the bounds of this disputed term." *Nautilus III*, 783 F.3d. at 1382-83. Specifically, after noting that the context of the claims shows that the space "cannot be greater than the width of a user's hands," the Court pointed to a line of the specification as establishing that "it is not feasible that the distance . . . be infinitesimally small." *Id.* Because the claim term was sufficiently bounded by the context of the claims and the specification, it was error to find that claim indefinite.

As in *Young* and *Nautilus III*, the specifications from both the Call Control and Broadband System patent families confirm the scope of "processing system" provided by the claims.[7]

1. The Call Control Specification

The Call Control specification mirrors the context of the claims and confirms that the processing system receives, processes, and transmits signaling:

[7] As explained *supra* in Statement of Facts, the six patents at issue here can be separated into two patent families based on shared specifications. "Call Control Patents" refers to the '932, '052, '3,561, and '6,561 Patents, while "Broadband Patents" refers to the '064 and '429 Patents.

> *The present invention also includes a telecommunications processing system which comprises an interface that is external to the switches and* ***is operational to receive and transmit signaling****. The processing system also includes a translator that is coupled to the interface and is operational to identify particular information in the received signaling and to* ***generate new signaling based on new information****.*

(A278, '3,561 Patent at 3:53-67 (emphasis added))

The specifications also provide detailed disclosure of the physical aspects of the claimed processing system. For instance, the Call Control specification states that the processing system "comprises ***an interface*** that is external to the switches." (A278, '3,561 Patent at 3:53-56 (emphasis added)) The Call Control specification also describes ***a signaling translator, a processor, and associated memory*** for processing information to select network characteristics. (A303 and A292, '3,561 Patent at 14:16-20 and FIG. 4) Indeed, with respect to the physical characteristics of the processing systems, the patents provide robust descriptions with respect to these known aspects of call processing control. For instance, the Call Control specification explains:

> ***The CCP is a processing system****, and as such, those skilled in the art are aware that such systems can be housed in a single device or distributed among several devices. Additionally, multiple devices with overlapping capabilities might be desired for purposes of redundancy. The present invention encompasses these variations. One such operational system would be multiple pairs of CCPs located regionally within a telecommunications system. Each machine would be equally capable of communication control.*

(A303, '3,561 Patent at 13:41-50 (emphasis added))

Referring to Figure 4, *see* A272, the Call Control specification explains how the disclosed structures of the CCP processing system "physically connect[s]" to various telecommunications signaling systems, such as Signal Transfer Points ("STPs"), switches, and Service Control Points ("SCPs"):

> *CCP 450 comprises interface 460, translator 470 operably connected to interface 460, processor 480 operably connected to translator 470, and memory 490 operably connected to processor 480.*
>
> *CCP 450 functions to physically connect incoming links from other devices such as STPs, switches, SCPs, and operational control systems. Interface 460 is functional to accept the signals off of these links and transfer the signals to translator 470. Interface 460 is also be able to transfer signaling from translator 470 to the links for transmission.*

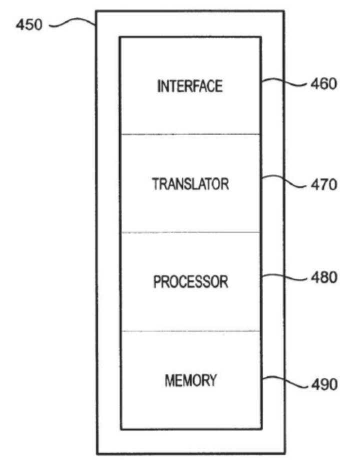

FIG. 4

(A303, '3,561 Patent at 14:16-27)

The Call Control specifications go on to provide columns of detail regarding the CCP's function with respect to each of these structural components, including for each component depicted in Fig. 4 (*see* A292):

> ***Interface 460*** *is functional to accept the signals off of these links and transfer the signals to translator 470… **Translator 470** accepts the signaling from interface 460 and identifies the information in the signaling. **Processor 480** accepts the signaling information from translator 470 and makes the selections that accomplish communication control… **Memory 490** is used by processor 480 to store programming, information, and tables.*

(A303, '3,561 Patent at 14:41-58) (emphasis added))

The Call Control specifications also provide logical diagrams depicting the CCP processing system's role within a network:

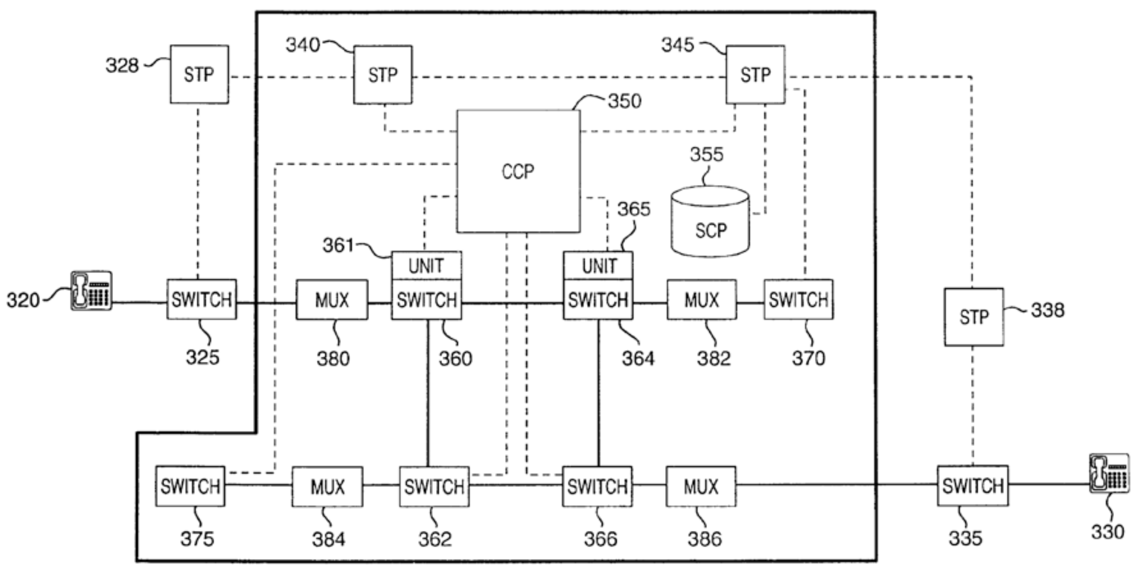

FIG. 3

(A291; A301-A303, '3,561 Patent at FIG. 3, 10:7 to 14:15; *see also* A967-A975; A999-A1000 (Sprint's expert, Dr. Wicker, discussing the meaning to skilled artisans of these descriptions within the context of claimed inventions))

Significantly, the specifications specifically name existing devices as exemplary processing systems:

> *The CCP performs many functions. ... The CCP is a processing system, and as such, those skilled in the art are aware that such systems can be housed in a single device or distributed among several devices. …* ***One example of a CCP device would be a Tandem CLX machine*** *configured in accord with this disclosure of the present invention.*

(A303, '3,561 Patent at 13:28-52 (emphasis added)) The Call Control specification thus identifies a litany of structural details, not the least of which is the identification of a known call processing system—a Tandem CLX device as would be "familiar to one skilled in the art." (A303, '3,561 Patent at 13:50-52). This is a tangible, concrete example of a processing system that the District Court failed to even acknowledge.

2. The Broadband System Specification

The Broadband System specification also mirrors the claims by discussing similar call processing functions for the disclosed call/connection processing systems:

> *Signaling processing system 160 is any processing platform that can* ***receive and process signaling*** *to select virtual connections, and then* ***generate and transmit signaling*** *to identify the selections. Various forms of signaling are contemplated by the invention, including SS7, C7, and user to network interface (UNI) signaling.*

(A407, '064 Patent at 4:26-33 (emphasis added))

In particular, the specifications in the Broadband System patents provide detailed physical descriptions of the "processing system." For example, the Broadband System specification discloses detailed descriptions of a call "signaling processing system" that "can receive and process signaling" to process calls between broadband and narrowband telephone systems. (A407, '064 Patent at 4:26-33) Call control is effected by the disclosed processing system via "links"

through the network to various network elements, such as "multiplexers," "cross-connect systems," and user devices, as generally depicted in Figure 1:

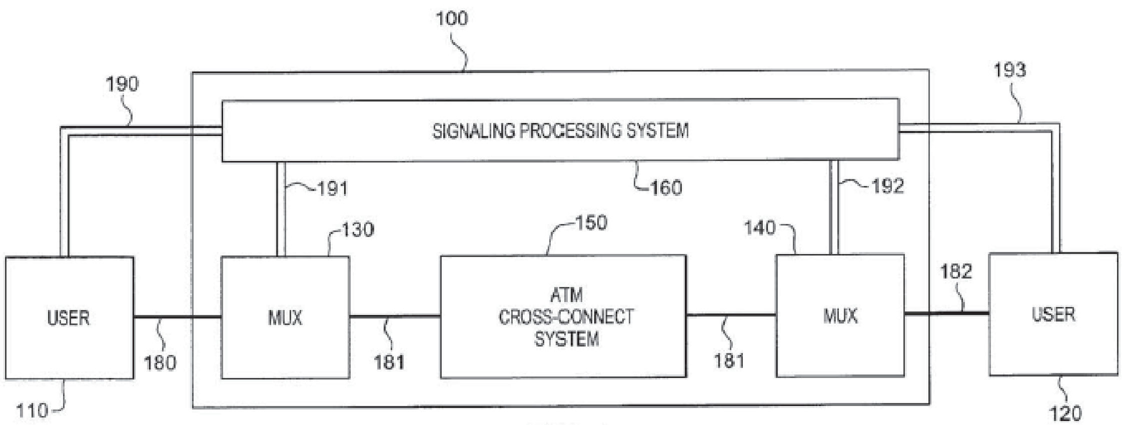

FIG. 1

(A407 and A394, '064 Patent at 3:42-52 and FIG. 1)

The Broadband System specification also provides robust discussions on the underlying structural components of the call processing systems. For instance, "FIG. 6 depicts a signaling processor suitable for the invention." (A410, '064 Patent at 10:66-67) As shown, the disclosed call processing system may include any number of known telecommunications structures to process telephone calls, including:

- Message Transfer Parts. "Signaling processor 610 includes Message Transfer Part (MTP) level 1 612, MTP level 2 615, and MTP level 3 620. MTP level 1 612 defines the physical and electrical requirements for a signaling link. MTP level 2 615 sits on top of level 1 and maintains reliable transport over a signaling link by monitoring status and performing error checks. ... MTP level 3 620 sits on top of level 2 and provides a routing and management function for the signaling system at large." (A411, '064 Patent at 11:5-15)

- Ethernet Interfaces. "Also shown for signaling processor 610 are ethernet interface 635," which "is a standard ethernet bus supporting TCP/IP which transfers signaling messages from MTP level 3 to platform handler 640." (A411, '064 Patent at 11:25-34)

- Platform Handlers. "Also shown for signaling processor 610" is "platform handler 640," which "is a system which accepts ISUP and B-ISUP messages from ethernet interface 635 and routes them to message handler 645." (A411, '064 Patent at 11:25-27, 11:45-50)

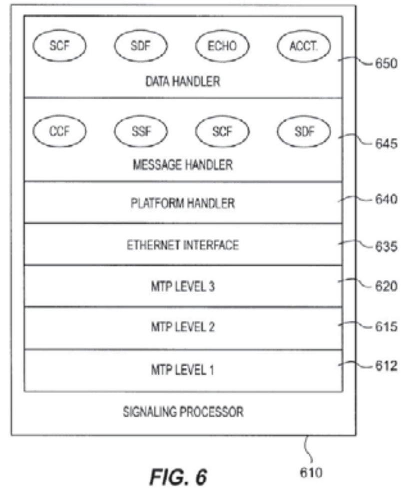

FIG. 6

- Message Handlers. "Also shown for signaling processor 610" is "data handler 650," which "would process the ISUP information" to "generate the appropriate ISUP message to implement the call...." (A411, '064 Patent at 11:25-27, 11:50-55)

- Data Handlers. "Also shown for signaling processor 610" is "message handler 645," which "is a set of logic coupled to message handler 645 which processes service requests and provides data to message handler 645" and "includes at least the SCF and the SDF...." (A411, '064 Patent at 11:25-27, 11:55-59, 12:29-39)

The Broadband System specification then includes columns and columns dedicated to describing the structural attributes of each component of the disclosed call/connection processing system. (A411-A412; A400, '064 Patent at 12:59 to 13:49, FIG. 7 ("platform handler"); A412-A413; A401, '064 Patent at 13:50 to 15:41, FIG. 8 ("message handler"); A413; A402, '064 Patent at 15:42 to 16:33, FIG. 9 ("data handler"))

Significantly, and once again, the Broadband System specification goes on to identify another existing device as an exemplary processing system:

> *Those skilled in the art are aware of various hardware components which can support the requirements of the invention.* ***For example, the platform handler, message handler, and data handler could each reside on a separate SPARC station 20****.*

(A411, ‘064 Patent at 12:52-56 (emphasis added))

In sum, the specifications describe the functional and structural aspects of “processing system,” even disclosing an existing device “familiar to one skilled in the art” as an exemplary “processing system.” This Court has long found such disclosure in the specification to support the definiteness of patent claims. *See Young*, 492 F.3d at 1346; *Nautilus III*, 783 F.3d at 1382. Sprint respectfully submits that the District Court’s conclusion that the specifications’ descriptions of the “processing system” that “do not pass muster under *Nautilus*” cannot be squared with the specifications’ actual disclosure when evaluated in the manner required by this Court’s precedent.

C. The Art Cited During Prosecution Confirms That Those Having Skill in the Relevant Art Understood the Scope of the Claimed “Processing Systems” With Reasonable Certainty

Sprint’s patents were deemed patentable by the Patent Office based on an informed review of the underlying state of the art. This cited art confirms the scope of the claimed “processing system” limitations was reasonably certain to those having ordinary skill in the art.

1. Patents Examined During the Prosecution of the Patents at Issue Provide Ample Background on the Relevant Characteristics of a "Processing System"

Various patents were considered during prosecution with respect to the claimed "processing systems," and Sprint's technical expert, Dr. Wicker, has explained that these prior art patents used the term "processing system" in a manner consistent with the usage of this term in Sprint's patents.

One such example is U.S. Patent No. 4,720,850 ("the '850 Patent"), which issued in 1988 to AT&T. (A999-A1000; A1011, '850 Patent at Abstract) Six years before Sprint's patents were first filed, the '850 Patent referred familiarly to a "call processing system design" in its specification. (A1011; A1035-A1036) Indeed, the "technical field" of the '850 Patent relates to:

> *The call processing and resource management portions of a communication system control arrangement, and particularly relates to the structure of the call processing portion and its cooperation with the resource management portion to provide different services to system subscribers by different means in a manner that is transparent to the subscriber terminal equipment.*

(A1035, '850 Patent at 1:19-26) Just as with Sprint's claims, the "[c]all processing subsystem" of the '850 Patent "is responsible for the establishment, management, and termination of subscriber calls" based on "requests from subscribers for communication services." (A1042, '850 Patent at 16:30-37)

Another example discussed in detail by Sprint's technical expert, Dr. Wicker, is U.S. Patent No. 6,016,343 ("the '343 Patent"), which was filed by Link

USA Corporation in 1996. (A999-A1000; A1073, '343 Patent at Title and Abstract) The '343 Patent is entitled "<u>Call-processing system</u> and method." (A1073, '343 Patent at Title) It discloses a "system and method for processing telephone calls" wherein the "<u>call processing system</u> includes a network control processor for controlling the processing and routing of the calls . . . ." (A1073, '343 Patent at Abstract) "FIG. 3 is a high-level block diagram illustrating a call processing system according to the present invention," which discussed the characteristics of the disclosed processing system as shown below:

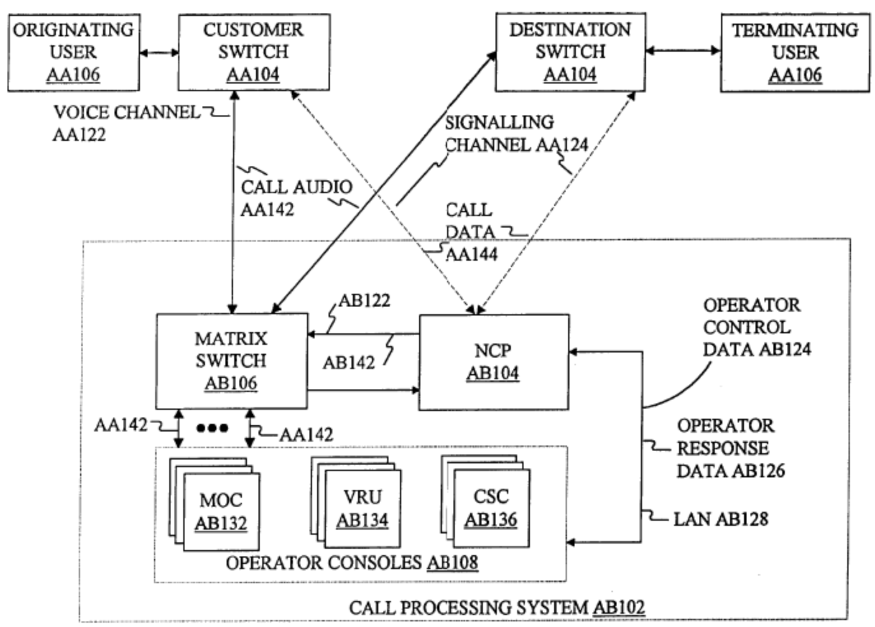

FIG 3

(A1287; A1076) The '343 Patent uses the phrase call "processing system" nearly 200 times, further corroborating that telecommunications artisans spoke to one another in the language of the claims and did so with more than reasonable clarity.

The ‘850 Patent was considered by the Patent Office during prosecution of ***all*** of the invalidated patents at-issue on appeal. (A412; A358; A311; A361; A285; A569) Further, the ‘343 Patent was cited on the face of all but one of the invalidated patents.[8] (A393; A339; A312; A362; A286)

2. The District Court Erroneously Gave Less Weight to these Disclosures as Extrinsic Evidence

The District Court misapplied the law by minimizing the legal importance of the cited art and referring to it as "extrinsic evidence." (A19 (emphasis added)) This was legal error, as "[t]his court has established that ‘prior art cited in a patent or cited in the prosecution history of the patent constitutes intrinsic evidence.’" *V-Formation, Inc. v. Benetton Grp. SpA*, 401 F.3d 1307, 1311 (Fed. Cir. 2005) (quoting *Kumar v. Ovonic Battery Co.*, 351 F.3d 1364, 1368 (Fed. Cir. 2003)); *Phillips v. AWH Corp.*, 415 F.3d 1303, 1317 (Fed. Cir. 2005) (*en banc*) ("The prosecution history, which we have designated as part of the "intrinsic evidence," consists of the complete record of the proceedings before the PTO and includes the prior art cited during the examination of the patent.").

Because the District Court erred in mischaracterizing the cited art, it necessarily erred in failing to properly weigh this evidence. By failing to consider the cited intrinsic art, the District Court committed further error. *All Dental Prodx, LLC v. Advantage Dental Products, Inc.*, 309 F.3d 774, 779-80 (Fed. Cir. 2002)

[8] The lone exception being U.S. Patent No. 7,286,561.

(relying on statements in the prosecution history to reverse indefiniteness, noting that the prosecution history is publicly available to would-be infringers and could "thus be relied upon to clarify the claim meaning and hence provide definiteness"); *Howmedica Osteonics Corp. v. Tranquil Prospects, Ltd.*, 401 F.3d 1367, 1374 (Fed. Cir. 2005) (reversing indefiniteness because references to the disputed claim language "in the discussion between the examiner and the applicant" were "relevant to the meaning . . . to one of skill in the art.")

Because these references cited during prosecution demonstrate the reasonably certain meaning of the claimed "processing systems" to those having ordinary skill, and because the District Court failed to properly consider and weigh this evidence below, this Court should reverse the invalidity holding.

D. The Extrinsic Evidence is Consistent with the Scope of "Processing System" Provided by the Intrinsic Record

Because the intrinsic evidence adequately informs those of skill in the art of the scope of the term "processing system," resorting to extrinsic evidence is unnecessary. *Personalized Media Commc'ns, L.L.C. v. Int'l Trade Com'n*, 161 F.3d 696, 706 (Fed. Cir. 1998). Even so, contemporaneous patents and expert testimony confirms that "processing system" was a commonly used term in the telecommunication field at the time of Sprint's invention and that "processing system" has long had an accepted meaning that matches Sprint's use of this terminology in its patents.

"Claim definiteness is analyzed not in a vacuum, but always in light of the teachings of the prior art and of the particular application disclosure as it would be interpreted by one possessing the ordinary level of skill in the pertinent art." *Energizer*, 435 F.3d at 1370 (internal quotes omitted). Accordingly, "[t]his court has repeatedly stated that a patent applicant need not include in the specification that which is already known to and available to a person of ordinary skill in the art." *Wellman, Inc. v. Eastman Chem. Co.*, 642 F.3d 1355, 1368 (Fed. Cir. 2011). Indeed, this Court has held that it is "err[or] in law" to insist that definiteness be established by intrinsic evidence alone, noting that "resolution of any ambiguity arising from the claims and specification may be aided by extrinsic evidence of usage and meaning of a term in the context of the invention." *Verve, LLC v. Crane Cams, Inc.*, 311 F.3d 1116, 1119 (Fed. Cir. 2002) (reversing indefiniteness for failure to fully consider extrinsic evidence).

In *Wellman, Inc. v. Eastman Chemical Co.*, this Court demonstrated the danger of overlooking extrinsic evidence in finding a claim indefinite. 642 F.3d 1355 (Fed. Cir. 2011). There, "[i]n holding the claims indefinite, the district court focused on the lack of specific moisture conditions for DSC testing, reasoning that the absence of intrinsic guidance would prevent a person of ordinary skill from understanding the bounds of the claims." *Id*. at 1367. This Court reversed, relying on expert testimony and industry specifications available in the field to conclude

that "[w]hile the claims do not recite specific moisture conditions, the well-known practice in this field as illustrated in [contemporary industry guidelines] made this a routine concern to a person of ordinary skill in the art." *Id*. at 1368.

1. Expert Testimony Confirms that "Processing System" was Used in Sprint's Patents in Accordance with its Well-Understood Meaning in the Art

In this case, as in *Wellman,* Sprint's expert testimony, along with contemporary patents, shows that the use of "processing systems" for call control was "a routine concern" in the industry even apart from the clear guidance in Sprint's patents. Specifically, Sprint's technical expert, Dr. Stephen Wicker, explained that "the term 'processing system' was known in the art at the time of the invention and refers to a system that processes signaling to assist in call control." (A992; *see also* A999-A1000) In support of this conclusion, Dr. Wicker discusses the disclosure in the patents' specifications, as well as additional patents cited on the face of Sprint's patent that likewise use the term "processing system" in accordance with the ordinary meaning proffered by Dr. Wicker. (A967-A978; A999-A1000)

Dr. Wicker further supports his opinion regarding the established meaning of "processing system" in the telecommunication field at the time by demonstrating that the term "processing system" is commonly found in the claims of patents in the telecommunications and related fields. (A999-A1000) Indeed, a simple patent

search shows that at least 25 other call control patents used the term "processing system" in the claims. (A999-A1000; *see also* A1381-A1383 (Cox's expert, Dr. Forys, discussing five of twenty-five patents identified by Sprint's expert referencing call "processing systems"))

In reviewing several of these patents, Dr. Wicker observes that, in the context of patents (like the ones in suit) addressed to call control, the term "processing system," is used consistent with its plain and ordinary meaning to refer to systems that process signaling to assist in call control. (A999-A1000) That "processing system" was freely used with little to no explanation in contemporary patents—including those cited on the face of the patents at issue here—reinforces Dr. Wicker's testimony that these phrases had an understood meaning in the telecommunications field at the time Sprint's patents issued.

While the District of Delaware commented that Cox's expert countered Dr. Wicker's opinions by pointing out that the term "processing system" was used "differently in a sampling of other patents," *see* A19, this criticism is unfounded. As the District of Kansas noted after reviewing the same declaration, Cox's expert failed to analyze the term in the ***context of the claims*** as Dr. Wicker properly did:

> *Defendants' expert has not explained how the particular patent* ***claims*** *containing this term are indefinite such that the scope of the claim could not be reasonably determined.*

(A838 (emphasis in original)); Comcast *Markman*, 2014 WL 5089402, *6; *see also Energizer Holdings, Inc. v. Int'l Trade Comm'n*, 435 F.3d 1366, 1370 (Fed. Cir. 2006) ("[The] definiteness inquiry focuses on whether those skilled in the art would understand the scope of the ***claim*** when the claim is read in light of the rest of the specification." (emphasis added, internal quotes omitted))[9] The District of Kansas also noted that Cox's expert did not show that the "processing system" of other patents was inconsistent with the scope provided by Sprint's claims:

> *Defendants' expert complains that he has not been told how to program the processing system, but* ***he concedes that the phrase must refer to some kind of computer to perform the tasks described in the patent****. He also notes that the system in the patents cited by Sprint's expert had different limitations, but* ***those differences do not undermine the basic idea that the term "processing system," by itself, would refer to a system of processing signals in specified ways****.*

(A838 (emphasis added)); Comcast *Markman*, 2014 WL 5089402, *6.[10]

As the District of Kansas established when reviewing the same expert declarations, the only record evidence regarding how one of skill in the art would understand the claimed "processing system" in the context of the intrinsic record is from Sprint's expert, Dr. Wicker. This fact alone warrants reversal of the indefiniteness finding. For example, in *Apple Inc. v. Samsung Electronics Co.*,

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[9] The District of Delaware failed to note this error. (A20.)

[10] The District of Delaware failed to see these errors as well, and also failed to consider the context of the claims when it looked to dictionary definitions for "processing system." (A17-A20.)

Ltd., this Court affirmed a finding of definiteness where the defendant "points to no evidence" that skilled artisans would be confused, while noting that the patentee's expert "cites a discussion in the specification of an embodiment" that "provides skilled artisans with enough information to understand what 'substantially centered' means in the patent." 786 F.3d 983, 1003 (Fed. Cir. 2015); *see also Ethicon Endo-Surgery, Inc. v. Covidien, Inc.*, 796 F.3d 1312, 1319 (Fed. Cir. 2015) (reversing indefiniteness: "Thus, unrebutted testimony in the record demonstrates that the focus of the '501 patent's specification and claims on *average* pressures is sufficient to signal to a skilled artisan how to arrive at the claimed force and pressure measurements.") (emphasis in original); *N. Am. Vaccine, Inc. v. Am. Cyanamid Co.*, 7 F.3d 1571, 1579 (Fed. Cir. 1993) (reversing indefiniteness because the defendant "did not meet its burden under the clear and convincing standard to show that one of ordinary skill would not understand what is included within claims 12 and 25.").

2. The District of Delaware Erred By Relying on Dictionaries Not Offered by the Parties and from the Wrong Technical Field

Finally, the District Court's independent reliance on computer dictionaries in the wrong technical field further demonstrates the District Court's flawed approach to the indefiniteness analysis.

This Court demonstrated in *Young* that the definiteness of a term varies based on the field of the art. *See Young v. Lumenis, Inc.*, 492 F.3d 1336, 1346 (Fed. Cir. 2007). There, the Court reversed a finding of indefiniteness, noting that because the word "near" in those patent claims describes "a location on an animal, its use, as opposed to a precise numerical measurement, is not inappropriate because the size of the appendage and the amount of skin required to be incised will vary from animal to animal based on the animal's size." *Id.*

Here, the District Court held there is no "established meaning in the art" for the disputed limitation, *see* A19, but did not identify the relevant field of art and apparently directed its inquiry to the general field of computers, *not the relevant field of telecommunications*. *Id.* (citing a "Dictionary of Computer Science," a "Dictionary of Computer and Internet Words," and a "Computer Dictionary). This flaw is fatal. Because the District Court failed to identify either the relevant art or the level of ordinary skill in that art, its indefiniteness holding must be reversed. *See Elcommerce.com, Inc. v. SAP AG.*, 745 F.3d 490, 505-06 (Fed. Cir. 2014) (reversing indefiniteness finding for failure to provide clear and convincing evidence from the perspective of a person of ordinary skill in the field of the invention), *vacated without opinion by joint request*, 564 Fed.Appx. 599 (Fed. Cir. 2014); *S3 Inc. v. NVIDIA Corp.*, 259 F.3d 1364, 1371 (Fed. Cir. 2001) (same).

Indeed, had the District Court focused its inquiry on the field of telecommunications, the evidence establishes, as Dr. Wicker explained with citations to the intrinsic record and contemporaneous patents, there would be no confusion as to what constitutes a "processing system" in the context of call control. Further, dictionaries within the relevant field of telecommunications, as opposed to the general field of computers, provide an established meaning of systems for call processing that matches Sprint's proffered meaning for "processing system." *See Newton's Telecom Dictionary* (Harry Newton, 8th ed. 1994), at p. 181 (defining "call processing" as "[t]he system and process that sets up the intended connection in a switching system.")[11]

When the extrinsic evidence is examined in light of Sprint's claims, the scope of "processing system" is confirmed to be reasonably certain, as "processing system" has long had an accepted meaning that matches Sprint's use of this

[11] Sprint respectfully requests that this Court take judicial notice, under Federal Rule of Evidence 201, of the cited *Newton's Telecom Dictionary* definition from the telecommunication industry to balance out the definitions from general computer dictionaries judicially noticed by the District Court. *See K/S Himpp v. Hear-Wear Techs., LLC*, 751 F.3d 1362, 1367 (Fed. Cir. 2014) (noting the Federal Circuit's "discretion to take judicial notice"). Neither Sprint nor Cox submitted, or were asked to submit, dictionary definitions in briefing the issue now on appeal, and the District Court's decision to *sua sponte* consider computer dictionary definitions after the close of briefing warrants judicial notice of the proffered definition from a telecommunication dictionary. *See* Wright & Miller, 21B Fed. Prac. & Proc. Evid. § 5110.1 (2d ed.) ("Judicial notice seems to be favored when the appellate court needs to take account of developments in the case subsequent to proceedings in the trial court.").

terminology in its patents. While the District Court may have searched for dictionary definitions of "processing system" in dictionaries directed generally to computers, the District Court did not properly consider the use of this terminology in the specific field of telecommunications or the context of the patents. (A19) When the proper field is considered along with the context provided by the intrinsic evidence, the scope of the claimed "processing system" is reasonably certain.

III. THE DISTRICT COURT'S INDEFINITENESS ANALYSIS WAS IMPROPER.

As set forth *supra*, the evidence does not support the District Court's indefiniteness judgment. To reach this erroneous result, the District Court applied a legally baseless "structural limitation" test that is inconsistent with this Court's indefiniteness authority.

A. The District Court Applied a Novel "Structural Limitation" Test, then Erroneously Disregarded Evidence It Deemed to be Functional.

The District Court followed an unsupported and erroneous approach in requiring Sprint to point to "structural limitations" in the patent in order to survive invalidity. (*See* A20) Specifically, the District Court erred by insisting on intrinsic evidence of "structural limitations" in a method claim, while ignoring the voluminous "recitation of . . . function" for a processing system that this Court has described as "highly relevant" in this context. *Nautilus III*, 783 F.3d at 1383.

1. The District Court Concluded that "Processing System" is a "Structural Limitation," And So Requires Disclosure of Physical Structure in the Claims or Specification

As discussed above, *Nautilus* requires that the scope of "processing system" be reasonably certain from the claims, read in light of the specification and other evidence. The District Court failed to perform this analysis. Instead, the District Court first concluded that "the asserted method claim contains a structural limitation, 'processing system.'" (A14-A20) The District Court then searched for corresponding "physical structures" in the specification. (A17-A18) The District Court held that "these physical structures" were only "functionally described by the claims and in the specifications" and thus "do not pass muster under *Nautilus*." (A18-A19) Finally, the District Court sought an industry definition of "processing system" by reviewing the expert declarations and various irrelevant computer dictionaries not submitted by the parties. (A19-A20) Finding no "established meaning in the art" based on these judicially noticed dictionary definitions, and finding that "the claim language and the specification do not provide structural limitations for the 'processing system,'" the District Court ruled that "processing system" was indefinite. (A20)

2. The District Court Erred in Disregarding All Evidence It Deemed Functional When Assessing the Meaning of "Processing System"

The District Court's insistence that "processing system" is a "structural limitation" that must be strictly linked to "physical structures" in the specification, independent of any functional description, finds no support in law. In fact, this Court in *Personalized Media* reversed the Commission for committing a similar error in assessing whether the term "digital detector" was indefinite in the context of a system claim. *Personalized Media Commc'ns, L.L.C.*, 161 F.3d at 705. The *Personalized Media* Court noted that the specification defined "digital detector" functionally as "a device that 'acts to detect the digital signal information' in another stream of information.'" *Id.* at 705-706. The Commission had found that this functional definition was grounds for indefiniteness:

> *The Commission makes much of the fact that the specification is otherwise silent concerning the structure of a "digital detector," and it notes that the "digital detectors" of the circuit diagrams do not reveal circuit elements constituting such a device, but only portray these devices as mere functional blocks.*

Id. at 706. The Federal Circuit rejected this reasoning, concluding that "the evidence relied upon by the Commission does not indicate imprecision of the claims. Instead, it is relevant, if at all, only to the sufficiency of the written description to enable the practice of the invention of the claims." *Id.*

The District Court in this case should be overturned on the same grounds. Its finding of indefiniteness rests on the grounds that "processing system" is described functionally in the specification (e.g., comprising "an interface . . . operational to receive and transmit signaling" and "a translator . . . operational to identify particular information in the received signaling and to generate new signaling based on new information." (A18) This would be even more inappropriate here than in *Personalized Media*, since that case was assessing system claims, whereas Sprint's claims are for methods.

Other examples abound of this Court holding that a claim term was sufficiently definite based on evidence of the claim term's function, even in the context of an apparatus claim. This Court, in *Nautilus III*, reversed indefiniteness of the term "spaced relationship" in an apparatus claim, noting that the surrounding "recitation of . . . function" in that claim was "highly relevant to ascertaining the boundaries of the 'spaced relationship.'" *Nautilus III*, 783 F.3d 1374, 1383.

Even *Halliburton Energy Servs., Inc. v. M-I LLC*, which Cox relied on heavily in front of the District Court, suggests that this Court would have found the claim term "fragile gel" to be definite had the patentee pointed to sufficient evidence of the gel's function. 514 F.3d 1244, 1256 (Fed. Cir. 2008) ("In other words, Halliburton's proposed construction of 'fragile gel' as used in the claims of the ′832 patent is indefinite because it is ambiguous as to the requisite degree of the

fragileness of the gel, ***the ability of the gel to suspend drill cuttings*** (i.e., gel strength), and/or some combination of the two.") (emphasis added); *see also Howmedica*, 401 F.3d at 1372 (reversing indefiniteness: "One of ordinary skill in this art would recognize that a one-dimensional linear measurement of the 'transverse sectional dimensions' would defeat the purpose of the invention to provide a snug fit of the prosthesis in the medullary canal."); *Ethicon Endo-Surgery, Inc. v. Covidien, Inc.*, 796 F.3d 1312, 1321-22 (Fed. Cir. 2015) (reversing indefiniteness for an apparatus claim: "the extrinsic evidence in the record here shows that although there are different methods of measuring the claimed average pressures, each of these methods is designed to provide similar measurements"); *c.f. Hill-Rom Services, Inc. v. Stryker Corp.*, 755 F.3d 1367, 1374-75 (Fed. Cir. 2014) (rejecting argument that "our construction is incorrect because it defines 'datalink' in functional terms," noting that "many devices take their names from the functions they perform" and that there "is nothing improper about defining 'datalink' as a link that conveys data") (internal quotes and alterations omitted); *K-2 Corp. v. Salomon S.A.*, 191 F.3d 1356, 1363 (Fed. Cir. 1999) (noting that "the functional language tells us something about the structural requirements of the attachment"); *Powell v. Home Depot U.S.A., Inc.*, 663 F.3d 1221, 1232-33 (Fed. Cir. 2011) (affirming construction of "table top" in an apparatus claim, informed by a "functional requirement" in the claims about what the table top must be capable of).

Likewise, the District Court further erred by rejecting Sprint's alternative construction of "a system that processes signaling to assist in call control" as allegedly "describ[ing] the 'processing system' by its function." (A20) In so doing, the District Court ran afoul of this Court's pronouncement in *Hill-Rom Services, Inc. v. Stryker Corp.* that:

> *[D]efining a particular claim term by its function is not improper. . . . Indeed, '[m]any devices take their names from the functions they perform. The examples are innumerable, such as 'filter,' 'brake,' 'clamp,' 'screwdriver,' or 'lock.'' There is nothing improper about defining 'datalink' as a link that conveys data. If one of skill in the art at the relevant time would understand that datalinks can be both wired and wireless, then the patentee is entitled to the full range of that claim term.*

755 F.3d 1367, 1374-75 (Fed. Cir. 2014) (citation and quotation omitted).

So too here. Like those items discussed in *Hill-Rom*, there was nothing improper with Sprint's proposal, and the District Court erred in rejecting it given the uncontroverted evidence demonstrating that "one of skill in the art at the relevant time would understand" that the claimed "processing systems" refer to call processing systems that "process[] signaling to assist in call control." (A961-A968; A986-A988; A999-A1000)

3. The Sole Case Cited Relied on by the District Court for this "Structural Limitation" Test Also Suggests the Approach was Incorrect

The ***only*** case relied upon by the District Court as part of its indefiniteness analysis, *Microprocessor Enhancement v. Texas Instruments*, does not support the District Court's indefiniteness holding. 520 F.3d 1367 (Fed. Cir. 2008). (A17-A18) In *Microprocessor*, the district court found that certain claims were "invalid for indefiniteness on the grounds that both claims impermissibly mix two distinct classes of patentable subject matter." *Id.* at 1374. On appeal, this Court stated that the "structure of claim 1 may be generally described as follows":

> A method of executing instructions in a pipelined processor comprising:
>
> [structural limitations of the pipelined processor];
>
> the method further comprising:
>
> [method steps implemented in the pipelined processor].

Id. After distinguishing past cases invalidating such claims, this Court concluded: "Direct infringement of claim 1 is clearly limited to *practicing* the claimed method in a pipelined processor possessing the requisite structure." *Id*. (emphasis in original). Importantly, this Court did not then search the intrinsic evidence for specific "physical structures" that correspond to the pipelined processor, nor did it suggest that any "functional language" should be disregarded in determining the bounds of this claim term. The District of Kansas agreed, correctly noting that *Microprocessor* "does not support defendants' argument." Comcast *Markman*, 2014 WL 5089402, at *6 n.3.

The District Court's novel approach is indefensible under controlling precedent. Because of the ample intrinsic and extrinsic evidence of the bounds of the recited "processing system" within the context of Sprint's patents discussed above, this Court should reverse the District Court's finding of indefiniteness.

B. Even Applying the District Court's Flawed Legal Analysis, the Evidence Establishes that the Claims are Definite.

When applying the District Court's flawed analysis, the District Court overlooked voluminous structural descriptions that easily satisfy the *Nautilus* test. Here, the parties agree that Sprint did not avail itself of the ***benefits*** of Section 112(f) through the convenience of means-plus-function or steps-plus-function claim drafting. (A20 at n. 9) As discussed above, the District Court appears to have charged Sprint with something like the ***burden*** of 112(f) by requiring Sprint to point to specific "physical structures" in the intrinsic evidence that correspond to the claimed "processing system." (A20) (concluding that "the claim language and the specification do not provide structural limitations for the 'processing system'"). Even assuming this approach were correct, Sprint's patents still easily satisfy the standard for definiteness under the heightened standards of 112(f).

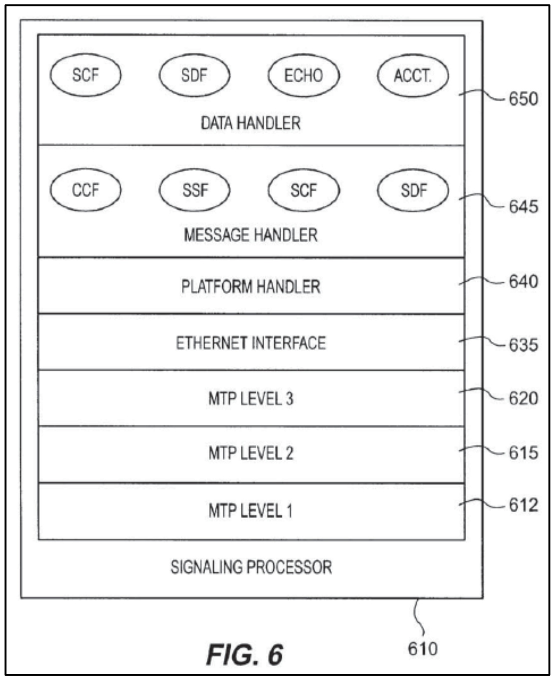
Under this inapplicable, heightened standard, the "requirement of specific structure in § 112, ¶ [f] . . . does not raise the specter of an unending disclosure of what everyone in the field knows that such a requirement in § 112, ¶ [a] would entail." *Typhoon Touch Techs., Inc. v. Dell, Inc.*, 659 F.3d 1376, 1384 (Fed. Cir.

2011) (quoting *Atmel Corp. v. Info. Storage Devices*, 198 F.3d 1374, 1382 (Fed. Cir. 1999)). Thus, the patent specification need not include "[d]etails of inner circuitry"; rather, "the specification need only disclose adequate defining structure to render the bounds of the claim understandable to an ordinary artisan." *Telcordia Technologies, Inc. v. Cisco Systems, Inc.*, 612 F.3d 1365, 1377 (Fed. Cir. 2010). For instance, this Court has reversed findings of indefiniteness for a means-plus-function claim where the "defendants have directed us to no evidence that a programmer of ordinary skill in the field would not understand how to implement this function." *Typhoon Touch*, 659 F.3d at 1385; *see also Lighting Ballast Control LLC v. Philips Elecs. N. Am. Corp.*, 790 F.3d 1329, 1339 (Fed. Cir. 2015) (affirming definiteness of apparatus claim previously determined to be in means-plus-function format, in part based on expert testimony that the "'voltage source means' limitation suggests to him a sufficient structure, or class of structures") (emphasis added).

The District Court's indefiniteness ruling would have been reversible error under this Court's means-plus-function jurisprudence. First, the District of Delaware agreed that there was physical structure disclosed in the specifications:

> ***These [CCM] recitations describe the physical structures identified as the "processing system," in which the claimed method is practiced.***

(A18-A19) These "physical structures," while glossed over by the District Court, easily satisfy the requirements of Section 112(f). *See* 35 U.S.C. § 112(F). In particular, the patent specifications identify the "Tandem CLX" or a "SPARC station 20" as well-known devices qualifying as a processing system. (A303, U.S. Patent No. 6,633,561 at 13:50-52 ("'3,561 Patent"); A411, U.S. Patent No. 6,298,064 at 12:52-56 ("'064 Patent")) Beyond that, and as described in more detail *supra*, the patents are replete with structural details and flow charts about the processing system: (A298, '3,561 Patent at 3:53-56) ("an interface that is external to the switches"); A303, '3,561 Patent at 13:41-50 ("housed in a single device or distributed among several devices"); A303, '3,561 Patent at 14:16-27) ("functions to physically connect incoming links from other devices such as STPs, switches, SCPs, and operational control systems")) Indeed, Figure 6 of the Broadband System specification includes a representation of a processing system housing various known telecommunications structures:



(A410, ‘064 Patent at 10:66-67)

This case is nothing like cases finding indefiniteness under 112(f), where the specification “provides no algorithm or description of structure corresponding to the claimed function.” *Finisar Corp. v. DirecTV Grp., Inc.*, 523 F.3d 1323, 1340 (Fed. Cir. 2008). Rather, under this Court’s clear jurisprudence, the patent specifications disclose more than enough even under the loftier standard of Section 112(f) that the District Court appears to have incorrectly applied. Therefore, the District Court’s indefiniteness holding fails both legally and factually and should be reversed.

CONCLUSION

Because the intrinsic and extrinsic evidence show that the scope of the claimed 'processing system" is defined with reasonable certainty, Sprint respectfully submits that the District of Delaware's judgment of invalidity for indefiniteness should be reversed.

Dated: December 18, 2015

Respectfully Submitted,

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CERTIFICATE OF COMPLIANCE
With Type-Volume Limitation, Typeface Requirements, and Type Style Requirements

1. This brief complies with the type-volume limitation of Fed. R. App. P. 32(a)(7)(B) because:

   this brief contains 12,199 words, excluding the parts of the brief exempted by Fed. R. App. P. 32(a)(7)(B)(iii).

2. This brief complies with the typeface requirements of Fed. R. App. P. 32(a)(5) and the type style requirements of Fed. R. App. P. 32(a)(6) because:

   this brief has been prepared in a proportionally spaced typeface using Microsoft Word in 14 Times New Roman.

Dated: December 18, 2015

/s/ B. Trent Webb
B. Trent Webb

CERTIFICATE OF FILING AND SERVICE

I hereby certify that, on this the 18th day of December 2015, I electronically filed the foregoing with the Clerk of Court using the CM/ECF System, which will send notice of such filing to all registered users.

I further certify that, upon acceptance and request from the Court, the required paper copies of the foregoing will be deposited with United Parcel Service for delivery to the Clerk, UNITED STATES COURT OF APPEALS FOR THE FEDERAL CIRCUIT, 717 Madison Place, N.W., Washington, D.C. 20439.

The necessary filing and service were performed in accordance with the instructions given to me by counsel in this case.

/s/ Melissa A. Dockery
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ADDENDUM

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IN THE UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF DELAWARE

COX COMMUNICATIONS INC., et al., Plaintiffs, v. SPRINT COMMUNICATIONS COMPANY L.P., et al., Defendants.	C.A. No. 12-487 SLR

[PROPOSED] RULE 54(b) FINAL JUDGMENT

WHEREAS, Plaintiffs filed a declaratory action for, *inter alia*, judgment of invalidity for failure to meet the conditions for patentability set forth in Title 35 of the United States Code, including Section 112, as to U.S. Patent Nos. 6,633,561 (Count 14);[1] 6,463,052 (Count 15);[2] 6,452,932 (Count 16); 6,473,429 (Count 17); 6,298,064 (Count 18); and 7,286,561 (Count 24) (collectively, the "Invalidated Patents") (D.I. 1);

WHEREAS, Defendants filed a second amended answer and counterclaims for, *inter alia*, infringement of the Invalidated Patents (Counts 9, 10, 11, 12, 13, 19) (D.I. 115);

WHEREAS, Plaintiffs answered Defendants' counterclaims and asserted, as their Second Affirmative Defense, that the Invalidated Patents, among others, are invalid for failure to meet the conditions for patentability set forth in Title 35 of the United States Code, including Section 112

[1] Count 14 is titled "Invalidity of the '3,561 Patent," but paragraph 149 erroneously references the '084 Patent. The parties are in agreement that Count 14 puts the validity of the '3,561 Patent at issue.

[2] Count 15 is erroneously titled "Invalidity of the '3,561 Patent," but paragraph 153 correctly references the '052 Patent. The parties are in agreement that Count 15 puts the validity of the '052 Patent at issue.

(D.I. 119);

WHEREAS, Plaintiffs moved, pursuant to Federal Rule of Civil Procedure 56, for partial summary judgment of invalidity as to the Invalidated Patents for failure to meet the definiteness requirement set forth in 35 U.S.C. § 112 (D.I. 207);

WHEREAS, the Court granted Plaintiffs' motion for partial summary judgment (D.I. 231);

WHEREAS, pursuant to Federal Rule of Civil Procedure 54(b), and for the reasons set forth in the Court's August 27, 2015, Memorandum Order (D.I. 298), the Court determines that there is no just reason for delay in entering final judgment of invalidity as to the Invalidated Patents;

NOW, THEREFORE, the Court directs entry of final judgment in Plaintiffs' favor as to Counts 14, 15, 16, 17, 18, and 24 of Plaintiffs' complaint (D.I. 1), and Counts 9, 10, 11, 12, 13, and 19 of Defendants' second amended counterclaims (D.I. 115).

SO ORDERED AND ADJUDGED this 3rd day of September, 2015.

UNITED STATES DISTRICT JUDGE

IN THE UNITED STATES DISTRICT COURT

FOR THE DISTRICT OF DELAWARE

COX COMMUNICATIONS INC., et al.,	)	
	)	
Plaintiffs,	)	
	)	
v.	)	Civ. No. 12-487-SLR
	)	
SPRINT COMMUNICATIONS COMPANY L.P., et al.,	)	
	)	
	)	
Defendants.	)	

MEMORANDUM ORDER

At Wilmington this 27th day of August, 2015, having conferred with counsel (D.I. 294), and having reviewed the papers submitted in connection with the most appropriate way to move the above captioned litigation forward;

IT IS ORDERED that:

1. **ATM Patents.**[1] There is a pending motion for partial summary judgment of invalidity or, in the alternative, noninfringement of Sprint's "ATM Patents." (D.I. 271)

2. **Comcast 1013 Patents.**[2] I understand that the parties are continuing their efforts to resolve their differences on how best to move forward with respect to the "Comcast 1013 Patents" and, therefore, I will not address such.

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[1]U.S. Patent Nos. 6,343,084; 6,330,224; 6,563,918; 6,262,992; and 6,697,340.

[2]U.S. Patent Nos. 6,870,832; 5,793,853; 6,452,931; 6,108,339; and 5,742,605.

3. **Invalidated Patents.**[3] With respect to the "Invalidated Patents," I have concluded that entry of a Rule 54(b) judgment is an appropriate procedural tool to accomplish what the Federal Circuit and Congress have encouraged (if not yet mandated) on the trial level, that is, to reduce the costs and inefficiencies of patent litigation through early dispositive rulings. Having determined, through a discrete motion practice on an issue of law, that these patents are invalid by reason of indefiniteness (D.I. 231), it makes imminent sense to have the Federal Circuit review my decision sooner rather than later. I believe this conclusion is consistent with the principles underlying Rule 54(b).

4. Rule 54(b) authorizes a district court to "direct entry of a final judgment as to . . . fewer than all claims or parties . . . if the court expressly determines that there is no just reason for delay." Fed. R. Civ. P. 54(b). According to the Federal Circuit,

> Rule 54(b) authorizes "an ultimate disposition of an individual claim entered in the course of a multiple claims action" in the "interest of sound judicial administration." *Sears, Roebuck & Co. v. Mackey*, 351 U.S. 427, 436-37 (1956). Even for claims that arise out of the same transaction or occurrence, sound case management may warrant entry of partial final judgment. District courts have substantial discretion in determining when there is not just cause for delay in entering judgment under Rule 54(b).

Integraph Corp. v. Intel Corp., 253 F.3d 695, 699 (Fed. Cir. 2001).

5. Sprint Communications Company, L.P. ("Sprint") argues that entry of a Rule 54(b) judgment is inappropriate on a number of grounds. Sprint argues that, as a procedural matter, I should not even entertain the request made by Cox Communications Inc., et al. ("Cox") because it was not presented by way of motion.

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[3]U.S. Patent Nos. 6,452,932; 6,463,052; 6,633,561; 7,286,561; 6,473,429; and 6,298,064.

The Federal Circuit has rejected that argument, however, in its *Integraph* decision:

> Integraph also argues that the district court had no authority *sua sponte* to enter judgment under Rule 54(b). That is incorrect. "[W]hether to allow an interim appeal is best decided by the trial court." *State Treasurer v. Barry*, 168 F.3d 8, 14 (11th Cir. 1999) (Rule 54(b) allows the district court to control its docket).
>
> The district court's action was authorized and appropriate, and is sustained.

Id. The request for entry of judgment was made by way of both a writing (D.I. 236) and orally (D.I. 294), to which Sprint responded thrice, twice in writing (D.I. 241, 252) and once at oral argument (D.I. 294). I have the authority to determine whether entry of judgment is appropriate, and have given Sprint the opportunity to weigh in on that determination.

6. Sprint also argues that the request lacks merit. In the first instance, Sprint argues that my indefiniteness decision is not final, because I did not decide all issues relating to the patents invalidated by that decision. Once again, the Federal Circuit has rejected that argument.

> The Supreme Court has stated that a district court's judgment is final where it "ends the litigation on the merits and leaves nothing for the court to do but execute the judgment." *Catlin v. United States,* 324 U.S. 229, 223 . . . (1945). Once the district court decided that Gore's patent was invalid or that IMPRA did not infringe Gore's patent, the district court no longer needed to address any of the other defenses. The law is clear that a "defendant need only sustain one decisive defense, not all of them." *Baumstimler v. Rankin,* 677 F.2d 1061, 1070 . . . (5th Cir. 1982).

W.L. Gore & Associates v. International Medical Prosthetics Research Associates, Inc., 975 F.2d 858, 863 (Fed. Cir. 1992). The cases cited by Sprint are not inconsistent with the above principle; they simply rest on different facts. More specifically, there were multiple parties in *Linear Tech. Corp. v. Impala Linear Corp.*, 2002 WL 398833 (Fed.

Cir. Feb. 15, 2002),[4] and unresolved claims that could change the disposition of the case in *National Oil Well Varco, L.P. v. Pason Systems USA Corp.*, 2009 WL 2903595 (Fed. Cir. Sept. 1, 2009).[5]

7. As indicated above, the background and procedural history of the case at bar is complex and distinguishable from the cases cited. On December 19, 2011, Sprint filed suit in the District of Kansas against two Cox entities, Cox Communications, Inc. and Cox Communications Kansas, LLC (both Delaware corporations), asserting infringement of multiple patents. (D.I. 1 at 15) Although the named defendants did not directly provide the accused telecommunications services or the equipment and technology used in the provision of the accused telecommunications products and services outside the State of Kansas, Sprint was seeking "complete relief" for all alleged infringement across Cox's national network. (D.I. 1 at 17) Consequently, Cox and

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[4]Based on its claim construction, the district court in *Linear* found that one defendant did not infringe and, thus, that defendant's motions for summary judgment of invalidity were moot. The second defendant had not moved for summary judgment regarding noninfringement. The district court entered Rule 54(b) judgments in favor of both defendants. The Federal Circuit concluded that the judgments were not properly entered, because the claim construction order had not been applied to the products of the second defendant and the parties had not agreed that "claim construction determined one way or another" was dispositive. 2002 WL 398833 at *2. The Court reasoned that, under those circumstances, it was likely that the Court "would be asked to again decide issues concerning the claim construction order in a subsequent appeal regarding the claims against" the second defendant. *Id.* at *3.

[5]The district court in *National* bifurcated the issues relating to inequitable conduct and held a jury trial on infringement and invalidity. The jury rendered a verdict finding that the patent was infringed and not invalid; the district court then *sua sponte* entered a Rule 54(b) judgment. The Federal Circuit appropriately found the entry of judgment to be improper because the inequitable conduct defense was still pending, which could conceivably change the disposition of the case even after the Federal Circuit's review on infringement and validity.

multiple of its affiliates filed the instant declaratory judgment action, asserting noninfringement and invalidity of the twelve Sprint patents asserted in the Kansas litigation. In February 2015, Cox filed a motion for partial summary judgment that the claims of the Invalidated Patents were invalid because the limitation "processing system" contained in each of the claims was indefinite. (D.I. 207) That motion was granted. (D.I. 231) Although there are issues that remain disputed in connection with the Invalidated Patents, the ATM Patents, the Comcast 1013 Patents, and the Cox Patents,[6] the resolution of such issues will not change the disposition of the case vis a vis the Invalidated Patents; i.e., there will be no trial in Delaware regarding the Invalidated Patents.

8. Sprint offers as a final argument the complications associated with entry of judgment in Delaware when the district court in Kansas has come to a contrary conclusion and the cases in Kansas[7] are scheduled to go to trial in January 2016. As I understand it, Sprint reasons that it makes more sense for the parties in Kansas to try all issues asserted in connection with the Invalidated Patents, so that the Federal Circuit can review all such issues before the trial in Delaware commences (the instant

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[6]U.S. Patent Nos. 7,992,172 and 7,836,474.

[7]*Sprint Communications Company L.P. v. Comcast Cable Communications, LLC, et al.,* Civ. No. 11-2684 (JWL) (D. Kan.); *Sprint Communications Company L.P. v. Cable One, Inc.,* Civ. No. 11-2685 (JWL) (D. Kan.); and *Time Warner Cable Inc., et al.,* Civ. No. 11-2686 (KHV/DJW) (D. Kan.). These defendants, as well as Cox, are customers of Cisco Systems, Inc. ("Cisco"), and Sprint's infringement allegations implicate Cisco products. Cisco has filed an invalidity declaratory judgment action in this court, *Cisco Systems, Inc. v. Sprint Communications Company, L.P.*, Civ. No. 15-431-SLR (D. Del.), and moved to intervene in the instant proceedings for the limited purpose of being heard on the Rule 54(b) issue. Said motion (D.I. 235) is granted.

case is currently scheduled for trial in February 2017).

9. As a practical matter, the realities of Sprint's proposal include the costs associated with (a) the three separate trials scheduled to go forward in Kansas (*see* D.I. 294 at 30), and (b) the verdict from each trial being subject to post-trial briefing and post-trial decisions by the district court in Kansas, all before the Federal Circuit would be in a position to entertain any appeals from the Kansas cases. I understand that the district court in Kansas need not stay the cases[8] (even a stay limited to the Invalidated Patents), but I am not persuaded that it makes sense for me to set the issue of indefiniteness aside for months when there is no just reason for delay.

10. In this regard, the multiple patents asserted in the instant case will not be tried before a single jury, but will be grouped by their similar technologies[9] for presentation to separate fact-finders. Because the Invalidated Patents will not be tried at all, the issue of indefiniteness will lie dormant in this case (as it will in the Kansas cases) for months. I conclude that, in the interest of sound judicial administration, there is no just reason for delaying the entry of judgment, in order to give the Federal Circuit the opportunity to resolve an issue over which district courts have differed, perhaps before either the Delaware or Kansas cases would be appealable in the normal course.

11. **Conclusion.** For the reasons stated, Cox's request for entry of final

[8]As I understand that the Federal Circuit may not accept my Rule 54(b) certification.

[9]For instance, as they have been grouped for purposes of this decision.

judgment as to the Invalidated Patents pursuant to Fed. R. Civ. P. 54(b) is granted.

IT IS FURTHER ORDERED that, on or before **September 2, 2015,** the parties shall present an order reflecting my decision to enter final judgment as to the Invalidated Patents pursuant to Rule 54(b).

United States District Judge

IN THE UNITED STATES DISTRICT COURT

FOR THE DISTRICT OF DELAWARE

COX COMMUNICATIONS INC., et al.,	)	
	)	
Plaintiffs,	)	
	)	
v.	)	Civ. No. 12-487-SLR
	)	
SPRINT COMMUNICATIONS COMPANY L.P., et al.,	)	
	)	
	)	
Defendants.	)	

MEMORANDUM ORDER

At Wilmington this 15th day of May, 2015, having reviewed plaintiffs' motion for partial summary judgment and construction of "processing system" (D.I. 207), and the papers filed in connection therewith;

IT IS ORDERED that plaintiffs' motion for partial summary judgment (D.I. 207) is granted, for the reasons that follow:

1. **Background.** On May 16, 2012, plaintiffs[1] (collectively "Cox") filed a

[1] Cox Communications, Inc.; CoxCom, LLC; Cox Arkansas Telcom, L.L.C.; Cox Communications Arizona, LLC; Cox Arizona Telcom, L.L.C.; Cox Communications California, LLC; Cox California Telcom, L.L.C.; Cox Colorado Telcom L.L.C.; Cox Connecticut Telcom, L.L.C.; Cox District of Columbia Telcom, L.L.C.; Cox Florida Telcom, L.P.; Cox Communications Georgia, LLC; Cox Georgia Telcom L.L.C.; Cox Iowa Telcom, L.L.C.; Cox Idaho Telcom L.L.C.; Cox Communications Kansas, L.L.C.; Cox Kansas Telcom, L.L.C.; Cox Communications Gulf Coast, L.L.c.; Cox Communications Louisiana, L.L.C.; Cox Louisiana Telcom, L.L.C.; Cox Maryland Telcom L.L.C.; Cox Missouri Telcom, LLC; Cox Nebraska Telcom, L.L.C.; Cox Communications Omaha, L.L.C.; Cox Nevada Telcom, L.L.C.; Cox Communications Las Vegas, Inc.; Cox North Carolina Telcom L.L.C.; Cox Ohio Telcom, L.L.C.; Cox Oklahoma Telcom, L.L.C.; Cox Rhode Island Telcom, L.L.C.; Cox Virginia Telcom, L.L.C.; and Cox Communications Hampton Roads, L.L.C.

declaratory action for invalidity and non-infringement of twelve Sprint patents,[2] and for infringement of two Cox patents[3] by defendants Sprint Communications Company L.P. ("Sprint Communications"), Sprint Spectrum, L.P. (Sprint Spectrum"), Sprint Solutions, Inc. ("Sprint Solutions") (collectively, Sprint). (D.I. 1) On September 17, 2013, Sprint filed, by stipulation, a second amended answer and counterclaims.[4] (D.I. 114; D.I. 115) On October 7, 2013, Cox answered Sprint's second amended counterclaims and asserted counterclaims.[5] (D.I. 119) On October 24, 2013, Sprint answered Cox's counterclaims. (D.I. 123) The court has jurisdiction pursuant to 28 U.S.C. §§ 1331 and 1338(a).

2. Plaintiff Cox Communications, Inc. (CCI) is a Delaware corporation with its principal place of business in Atlanta, Georgia. CCI provides general corporate, accounting, and management services to the other Cox plaintiffs. CCI is the direct or indirect parent of the other Cox plaintiffs. (D.I. 1 at ¶ 4) CoxCom, LLC ("CoxCom") is a Delaware corporation with its principal place of business in Atlanta, Georgia. CoxCom is a wholly owned subsidiary of CCI and does not directly provide telephony services or

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[2] U.S. Patent Nos. 6,452,932 ("the '932 patent"); 6,463,052 ("the '052 patent"); 6,633,561 ("the '3,561 patent"); 7,286,561 ("the '6,561 patent"); 6,473,429 ("the '429 patent"); 6,298,064 ("the '064 patent"); 6,343,084; 6,262,992; 6,330,224; 6,563,918; 6,639,912; and 6,697,340.

[3] U.S. Patent Nos. 7,992,172 and 7,836,474.

[4] Having previously filed an answer and counterclaims for infringement of seven other Sprint patents, U.S. Patent Nos. 5,742,605; 6,108,339; 6,452,931; 6,870,832; 8,121,028; 5,793,853; and 7,995,730, on July 9, 2012 (D.I. 41) and, by stipulation, a first amended answer and counterclaims for infringement of each of the nineteen Sprint patents on July 12, 2013 (D.I. 96, 97). Sprint's counterclaims are asserted by Sprint Communications and Sprint Spectrum only.

[5] Having previously filed an answer to Sprint's counterclaims and asserted counterclaims on August 13, 2012 (D.I. 53) and filed an answer to Sprint's first amended counterclaims and asserted counterclaims on August 2, 2013 (D.I. 102).

technology to end users. CoxCom is the parent of each of the Cox plaintiffs except for Cox Communications Georgia, LLC, Cox Georgia Telcom, LLC, Cox Communications Las Vegas, Inc., LLC, and Cox Nevada Telcom LLC, all of which are direct or indirect subsidiaries of CCI. CoxCom supplies certain of the Cox plaintiffs with technology used by those entities in providing telephony products and services, including the Cox Digital Telephone and SIP Trunking service and other related telephony services. (D.I. 1 at ¶ 5) Each of the other Cox plaintiffs are Delaware corporations with principal places of business in the corresponding State in which it is located. (D.I. 1 at ¶¶ 6-35) The Cox plaintiffs are leading cable entertainment and broadband services providers, and amongst other things, are well known for pioneering the bundling of television, Internet and telephone services together, offering consumers the ability to consolidate these services with one provider. (D.I. 1 at ¶ 58)

3. Defendants Sprint Communications Company L.P. and Sprint Spectrum L.P. are limited partnerships organized and existing under the laws of the State of Delaware, with principal places of business in Overland Park, Kansas. (D.I. 115 at 23, ¶¶ 1-2) Defendant Sprint Solutions is a corporation organized and existing under the laws of the State of Delaware, with a principal place of business in Overland Park, Kansas. (D.I. 115 at ¶¶ 40, 56) Sprint is a provider of wireless and wireline communications services. (D.I. 1 at ¶ 59)

4. **Standard.** "The court shall grant summary judgment if the movant shows that there is no genuine dispute as to any material fact and the movant is entitled to judgment as a matter of law." Fed. R. Civ. P. 56(a). The moving party bears the burden of demonstrating the absence of a genuine issue of material fact. *Matsushita Elec.*

Indus. Co. v. Zenith Radio Corp., 415 U.S. 475, 586 n. 10 (1986). A party asserting that a fact cannot be—or, alternatively, is—genuinely disputed must be supported either by citing to "particular parts of materials in the record, including depositions, documents, electronically stored information, affidavits or declarations, stipulations (including those made for the purposes of the motions only), admissions, interrogatory answers, or other materials," or by "showing that the materials cited do not establish the absence or presence of a genuine dispute, or that an adverse party cannot produce admissible evidence to support the fact." Fed. R. Civ. P. 56(c)(1)(A) & (B). If the moving party has carried its burden, the nonmovant must then "come forward with specific facts showing that there is a genuine issue for trial." Matsushita, 415 U.S. at 587 (internal quotation marks omitted). The Court will "draw all reasonable inferences in favor of the nonmoving party, and it may not make credibility determinations or weigh the evidence." *Reeves v. Sanderson Plumbing Prods., Inc.,* 530 U.S. 133, 150 (2000).

5. To defeat a motion for summary judgment, the non-moving party must "do more than simply show that there is some metaphysical doubt as to the material facts." *Matsushita*, 475 U.S. at 586-87; *see also Podohnik v. U.S. Postal Service*, 409 F.3d 584, 594 (3d Cir. 2005) (stating party opposing summary judgment "must present more than just bare assertions, conclusory allegations or suspicions to show the existence of a genuine issue") (internal quotation marks omitted). Although the "mere existence of some alleged factual dispute between the parties will not defeat an otherwise properly supported motion for summary judgment," a factual dispute is genuine where "the evidence is such that a reasonable jury could return a verdict for the nonmoving party." *Anderson v. Liberty Lobby, Inc.*, 477 U.S. 242, 247-48 (1986). "If the evidence is merely

colorable, or is not significantly probative, summary judgment may be granted." *Id.* at 249-50 (internal citations omitted); *see also Celotex Corp. v. Catrett*, 477 U.S. 317, 322 (1986) (stating entry of summary judgment is mandated "against a party who fails to make a showing sufficient to establish the existence of an element essential to that party's case, and on which that party will bear the burden of proof at trial").

6. **Analysis.** The disputed limitation, "processing system," is present in the '932, '052, '3,561, and '6,561 patents (the "Control Patents"), which share a specification, and the '064 and '429 patents (the "ATM Interworking Patents"), which share a specification. Exemplary claim 1 of the '3,561 patent recites:

> A method of operating a **processing system** to control a packet communication system for a user communication, the method comprising:
> receiving a signaling message for the user communication from a narrowband communication system into the **processing system**;
> processing the signaling message to select a network code that identifies a network element to provide egress from the packet communication system for the user communication;
> generating a control message indicating the network code;
> transferring the control message from the **processing system** to the packet communication system
> receiving the user communication in the packet communication system and using the network code to route the user communication through the packet communication system to the network element; and
> transferring the user communication from the network element to provide egress from the packet communication system.

('3,561 patent, 22:12-32) (emphasis added) The parties dispute whether the limitation "processing system" is indefinite.

7. The definiteness requirement is rooted in § 112, ¶ 2, which provides that "the specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention." "A determination of claim indefiniteness is a legal conclusion that is drawn from the court's

performance of its duty as the construer of patent claims." *Personalized Media Comm., LLC v. Int'l Trade Com'n*, 161 F.3d 696, 705 (Fed. Cir. 1998). Reiterating the public notice function of patents, the Supreme Court recently explained that "a patent must be precise enough to afford clear notice of what is claimed, thereby 'appris[ing] the public of what is still open to them.'" *Nautilus, Inc. v. Biosig Instruments, Inc.*, —— U.S. ——, 134 S.Ct. 2120, 2129 (2014) (citations omitted). In balancing the need for clarity with the inherent limitations of the English language, 35 U.S.C. § 112, ¶ 2 requires "that a patent's claims, viewed in light of the specification and prosecution history, inform those skilled in the art about the scope of the invention with reasonable certainty." *Id.*

8. Sprint proposes using the "plain and ordinary meaning" of the limitation "processing system" or construing the limitation as "a system that processes signaling to assist in call control." (D.I. 224 at 10-12, 20) Sprint's expert explained:

> 31. The ["communication control processor" ("CCP")] performs call processing functions using, among other things, signaling that reaches the CCP to selects (or participate in the selection of) network characteristics for the call. The CCP may be composed of one or many physical components as is discussed in the specification.
>
>> The CCP is a processing system and as such, those skilled in the art are aware that such systems can be housed in a single device or distributed among several devices. Additionally, multiple devices with overlapping capabilities might be desired for purposes of redundancy. The present invention encompasses these variations. ('052 patent, 13:37-42)
>
> . . .
>
> 69. The term "processing system" has an understood meaning in the telecommunications industry by a person of ordinary skill in the art. For example, the '052 Patent specification discusses its meaning. (*See* ¶ 3[1]). Also, the '429 Patent references a patent using the term. (U.S. Patent No. 4,720,850 ["the '850 patent"]) as does the '064 patent (6,016,343 ["the '343 patent"]). As this evidence indicates, the term

> "processing system" was known in the art at the time of invention and refers to a system that processes signaling to assist in call control.

(D.I. 216, ex. A at ¶¶ 69, 31) Sprint's expert also opined that the Sprint patents reference other patents which use the phrase "processing system," demonstrating that a person of ordinary skill in the art would have known with reasonable certainty what is meant by the limitation. (D.I. 216, ex. B at ¶ 14)

9. Cox, on the other hand, argues that the limitation is indefinite, because the structural limitation, "processing system," is only described functionally. (D.I. 221 at 11-13) Alternatively, Cox asserts that the limitation should be construed as a CCP for the Control patents and a "call connection manager" ("CCM") for the ATM Interworking patents, which construction is still indefinite as the disclosures for each of these devices are purely functional. (*Id.* at 15-21) In support of the same indefiniteness argument, an expert for Comcast[6] disagreed with Sprint's expert and opined that there is no "known, well-understood meaning" of processing system. Instead, Comcast's expert selected five patents (of the twenty five identified by Sprint's expert as using "processing system" in their claims) and explained that "the phrase is used differently in each of the [five] patents [he] sampled, with different structures: at the very least the processors involved have specialized software to perform their widely differing functions." (D.I. 218, ex. I at ¶ 3)

10. At the outset, "[w]hile not an absolute rule, all claim terms are presumed to have meaning in a claim." *Innova/Pure Water, Inc. v. Safari Water Filtration Sys., Inc.*, 381 F.3d 1111, 1119 (Fed. Cir. 2004). "Functional language in claims [today] is not

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[6] In *Sprint Commc'ns Co. L.P. v. Comcast Cable Commc'ns, LLC*, Civ. No. 11-2684 at D.I. 361 (D. Kan. 2011).

objectionable per se so long as it avoids . . . problems of undue breadth and vagueness." 3 Donald S. Chisum, *Chisum on Patents* § 8.04 (2015). The Federal Circuit recently reiterated that "when a claim limitation is defined in 'purely functional terms,' a determination of whether the limitation is sufficiently definite is 'highly dependent on context (e.g., the disclosure in the specification and the knowledge of a person of ordinary skill in the relevant art area).'" *Biosig Instruments, Inc. v. Nautilus, Inc.*, --- F.3d ----, 2015 WL 1883265, *3 (Fed. Cir. 2015) (citing *Halliburton Energy Servs., Inc. v. M-I LLC*, 514 F.3d 1244, 1255 (Fed. Cir. 2008)). However, "in some instances, use of functional language can fail 'to provide a clear-cut indication of the scope of subject matter embraced by the claim' and thus can be indefinite." *Halliburton Energy*, 514 F.3d at 1255 (citing *In re Swinehart*, 439 F.2d 210, 212-13 (C.C.P.A. 1971)).

11. In *Microprocessor Enhancement Corp. v. Texas Instruments Inc.*, 520 F.3d 1367 (Fed. Cir. 2008), the Federal Circuit analyzed a method claim that recited structural elements: A "method of executing instructions in a pipelined processor comprising: [structural limitations of the pipelined processor]; the method further comprising: [method steps implemented in the pipelined processor]." *Id.* at 1374. The Court explained that "[m]ethod claim preambles often recite the physical structures of a system in which the claimed method is practiced" and "[d]irect infringement of [the] claim . . . is clearly limited to practicing the claimed method in a pipelined processor possessing the requisite structure." *Id.* at 1374-75.

12. As in *Microprocessor Enhancement*, the asserted method claim contains a structural limitation, "processing system." This limitation is found not only in the

preamble, but in the body of the claim. The specification of the Control patents describes each figure as "a block diagram of a version of the invention" ('3,561 patent, 4:42-51), with a CCP depicted in each figure.[7] The specification describes the processing system as

> a telecommunications processing system which comprises an interface that is external to the switches and is operational to receive and transmit signaling. The processing system also includes a translator that is coupled to the interface and is operational to identify particular information in the received signaling and to generate new signaling based on new information.

('3,561 patent, 3:53-59) In describing the CCP, the specification explains that it "is a processing system, and as such, those skilled in the art are aware that such systems can be housed in a single device or distributed among several devices." (*Id.* at 13:41-43) For the ATM Interworking patents, the specification explains that:

> Signaling processing system 160 is any processing platform that can receive and process signaling to select virtual connections, and then generate and transmit signaling to identify the selections. Various forms of signaling are contemplated by the invention, including SS7, C7, and user to network interface (UNI) signaling. A preferred embodiment of the signaling processor is discussed in detail toward the end of the disclosure.

('064 patent, 4:26-33) The specification then identifies the CCM as "a signaling processor that operates as discussed above." (*Id.* at 6:54-55) These recitations describe the physical structures identified as the "processing system," in which the claimed method is practiced. The court concludes that these physical structures (functionally described by the claims and in the specifications) do not

[7] Figure 4 depicts "main capabilities of one version of a CCP" ('3,561 patent, 14:17) and figures 5-8 are flow diagrams of the CCP for certain versions of the present invention (*id.* at 14:59-60, 15:64-65, 18:4-5, 18:52-53).

pass muster under *Nautilus* as a person of ordinary skill in the art is not provided with the bounds of the claimed invention.

13. Turning to extrinsic evidence, the '850 patent cited by Sprint's expert contains a singular reference to "processing system," that is "call processing system design." ('850 patent, 3:14-15) The '850 patent describes a "program-controlled call processing arrangement;" one embodiment "comprises (a) a point-to-point call processing arrangement for handling conventional point-to-point calls, and (b) a broadcast service vendor call processing arrangement for handling calls to broadcast program source channels." (*Id.* at abstract; 4:9-14) The '343 patent cited by Sprint's expert is directed to a "call processing system," which is structurally described as "a network control processor for controlling the processing and routing of the calls and for providing enhanced features, and a matrix switch for routing calls from an originating location to a terminating location." ('343 patent, abstract) As explained by Comcast's expert above, the limitation "processing system" is used differently in a sampling of other patents. Moreover, the parties have not provided, nor has the court found, a dictionary definition for the phrase "processing system." *See e.g., Dictionary of Computer Science* (Valerie Illingworth et al. eds., 4th ed. 2001); *Dictionary of Computer and Internet Words [an A to Z Guide to Hardware, Software, and Cyberspace]* (2001); *Microsoft Computer Dictionary* (1999). The court concludes that there is no "established meaning in the art" for the disputed limitation.[8]

[8] In contrast the Federal Circuit in *DDR Holdings, LLC v. Hotels.com*, 773 F.3d 1245 (Fed. Cir. 2014) found "that [the limitation] 'look and feel' had an established, sufficiently objective meaning in the art, and that the '399 patent used the term consistent with that meaning," which "viewed in light of the specification and prosecution history, informed

14. Sprint's proposed construction of "a system that processes signaling to assist in call control" describes the "processing system" by its function. Likewise, Sprint's argument that any system performing the steps of the method infringes offers no "objective boundaries" for those skilled in the art to determine the scope of the invention. The court concludes that the claim language and the specification do not provide structural limitations for the "processing system" and do not inform those skilled in the art about the scope of the invention with reasonable certainty.[9] The limitation is indefinite.[10]

15. **Conclusion.** For the aforementioned reasons, plaintiffs' motion for partial summary judgment (D.I. 207) is granted.

United States District Judge

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those skilled in the art about the scope of the '399 patent's claims with reasonable certainty." *Id.* at 1260-61.

[9] The parties agree that the means-plus-function format of 35 U.S.C. § 112(f) and corresponding arguments do not apply to the case at bar. (D.I. 222 at 4)

[10] The court respectfully recognizes that this conclusion is contrary to that of *Sprint Commc'ns Co. L.P. v. Comcast Cable Commc'ns, LLC*, Civ. No. 11-2684 at D.I. 435, 435 (D. Kan. 2011), declining to construe "processing system."

EXHIBIT D

US006633561B2

(12) **United States Patent**
Christie

(10) **Patent No.:** **US 6,633,561 B2**
(45) **Date of Patent:** ***Oct. 14, 2003**

(54) **METHOD, SYSTEM AND APPARATUS FOR TELECOMMUNICATIONS CONTROL**

(75) Inventor: **Joseph Michael Christie**, San Bruno, CA (US)

(73) Assignee: **Sprint Communications Company, L.P.**, Overland Park, KS (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

This patent is subject to a terminal disclaimer.

(21) Appl. No.: **10/002,850**

(22) Filed: **Nov. 14, 2001**

(65) **Prior Publication Data**

US 2002/0039372 A1 Apr. 4, 2002

Related U.S. Application Data

(63) Continuation of application No. 09/082,040, filed on May 20, 1998, which is a continuation of application No. 08/568,551, filed on Dec. 7, 1995, now Pat. No. 5,825,780, which is a continuation of application No. 08/238,605, filed on May 5, 1994, now abandoned.

(51) **Int. Cl.**[7] **H04L 12/66**
(52) **U.S. Cl.** **370/352**; 370/356; 370/410; 370/522; 379/230
(58) **Field of Search** 370/352–356, 370/401, 410, 389, 422, 426, 351, 360, 522; 379/221.08, 221.09, 221.12, 221.14, 228, 229, 230, 221.1, 219

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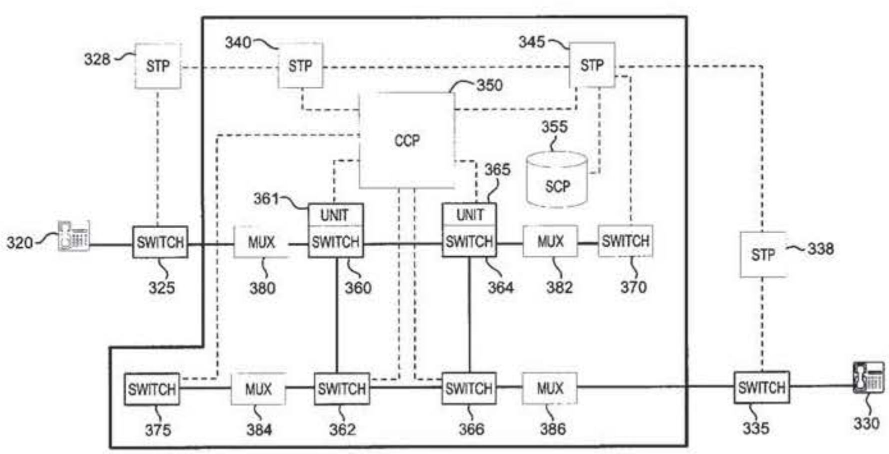
(List continued on next page.)

Primary Examiner—Ajit Patel

(57) **ABSTRACT**

The present invention includes a method, system, and apparatus for providing communication control. The invention includes a method in which signaling is processed externally to a switch before it is applied by the network elements. The processor is able to select network characteristics and signal the network elements based the selections. A network employing the processing method is also included, as well as a signaling system that employs the processing method.

38 Claims, 8 Drawing Sheets



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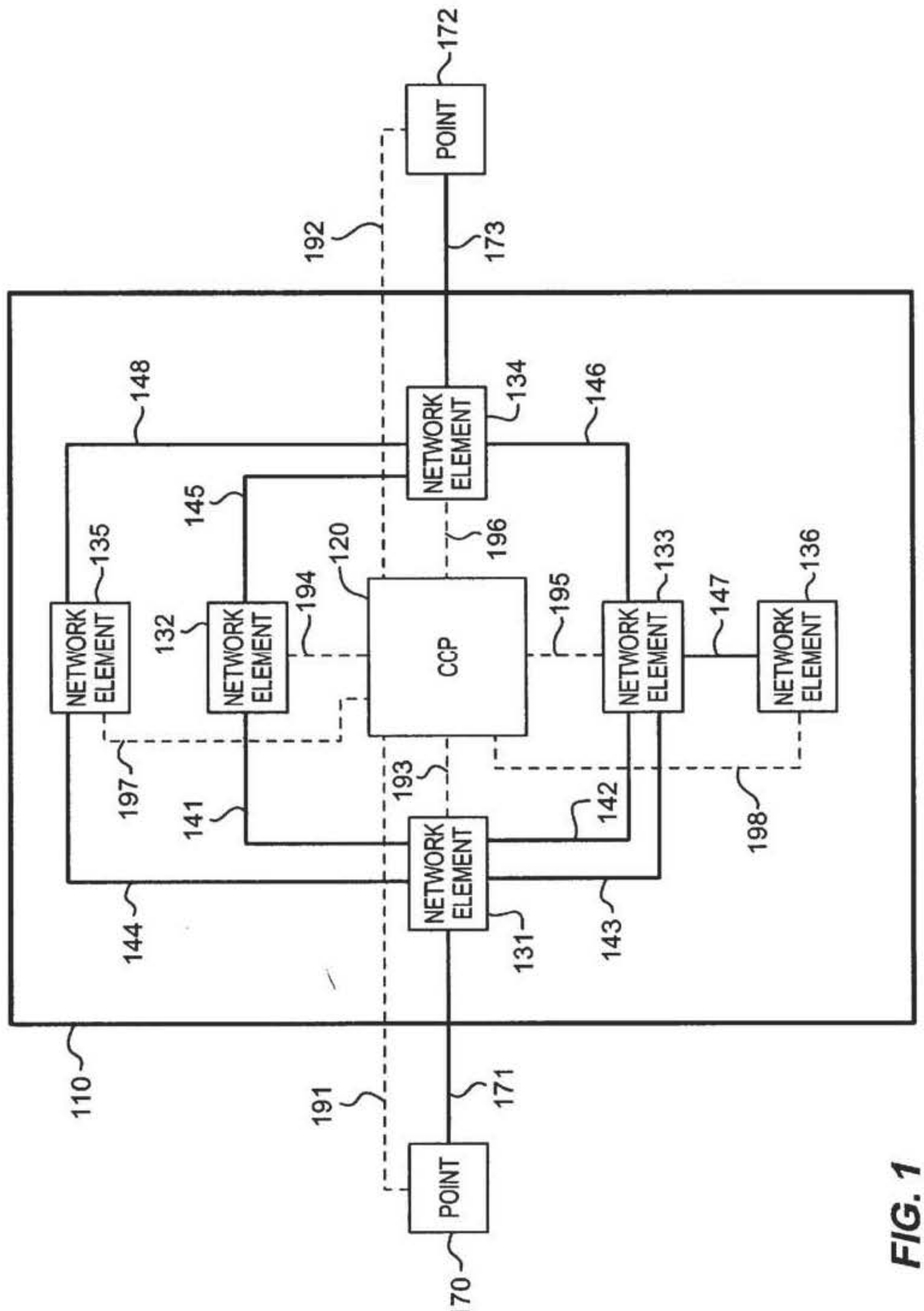
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192
173
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134
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146
145
196
120
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NETWORK ELEMENT
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NETWORK ELEMENT
194
CCP
195
133
NETWORK ELEMENT
147
136
NETWORK ELEMENT
197
193
141
142
198
NETWORK ELEMENT
144
131
143
191
171
POINT
170

FIG. 1

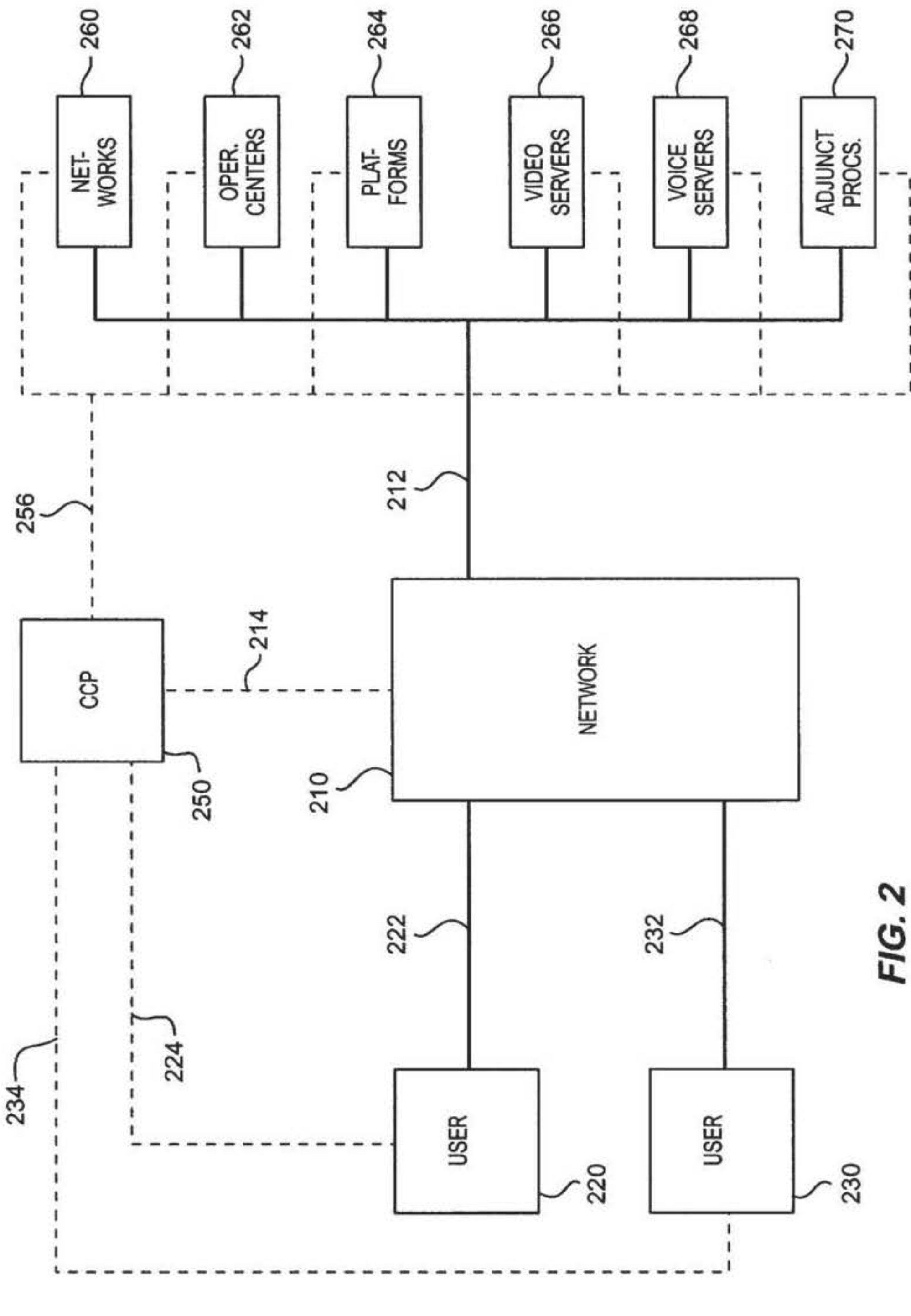
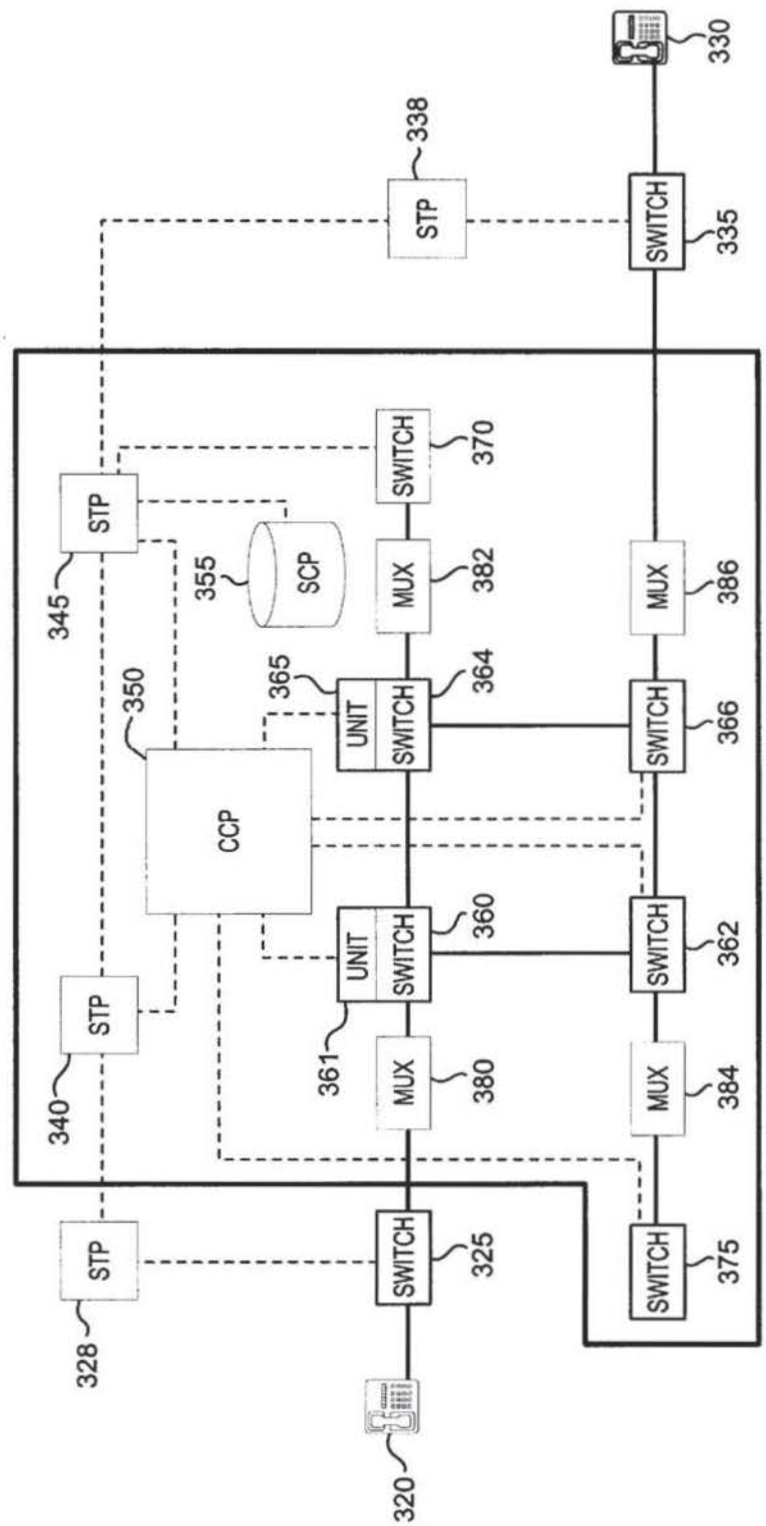

260
NET-WORKS
262
OPER. CENTERS
264
PLAT-FORMS
266
VIDEO SERVERS
268
VOICE SERVERS
270
ADJUNCT PROCS.
256
212
CCP
214
250
210
NETWORK
222
232
224
234
USER
220
USER
230

FIG. 2


330
338
STP
SWITCH
335
STP
345
SWITCH
370
SCP
355
MUX
382
MUX
386
350
365
UNIT
SWITCH
364
SWITCH
366
CCP
UNIT
SWITCH
360
SWITCH
362
STP
340
361
MUX
380
MUX
384
STP
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SWITCH
325
SWITCH
375
320

FIG. 3

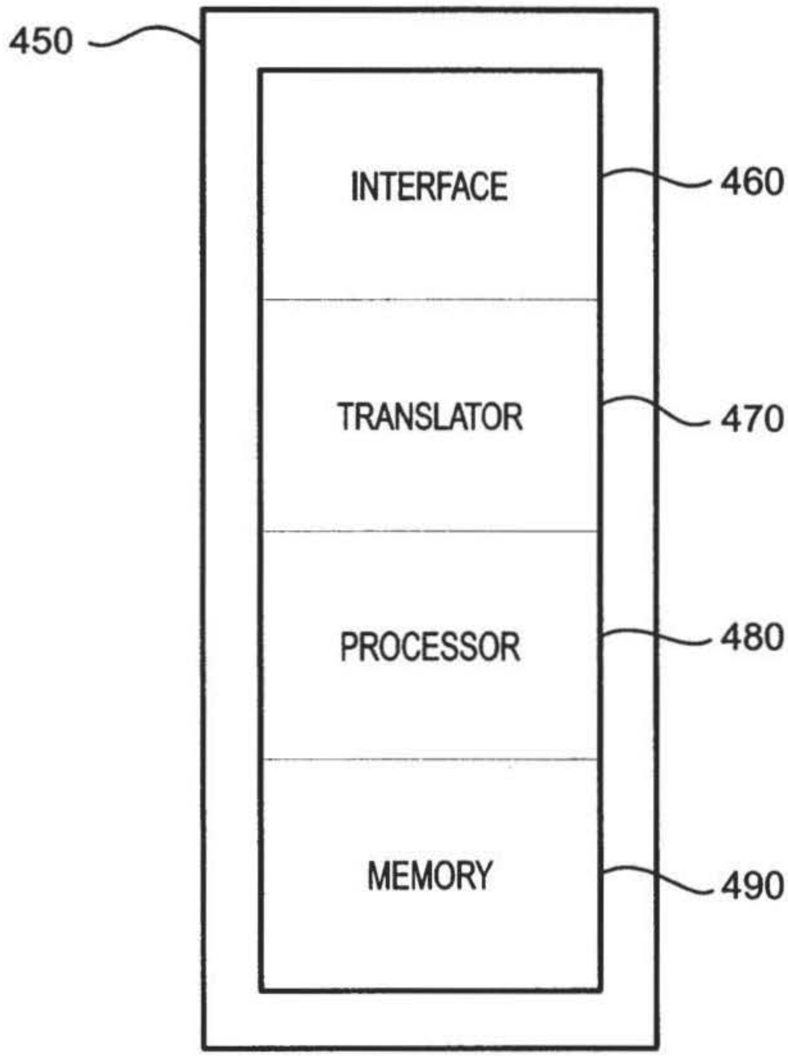

FIG. 4

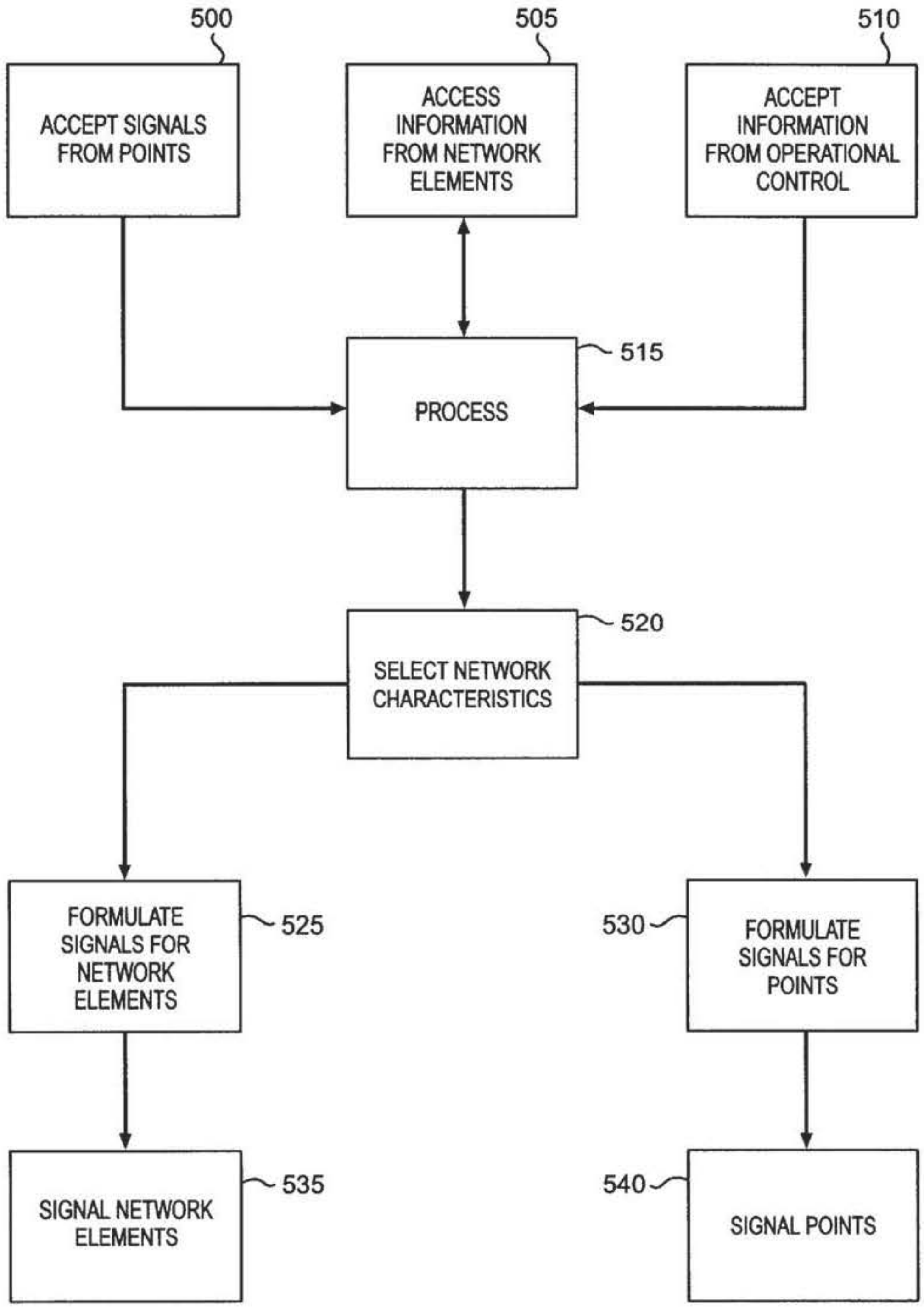
500
ACCEPT SIGNALS FROM POINTS
505
ACCESS INFORMATION FROM NETWORK ELEMENTS
510
ACCEPT INFORMATION FROM OPERATIONAL CONTROL
515
PROCESS
520
SELECT NETWORK CHARACTERISTICS
525
FORMULATE SIGNALS FOR NETWORK ELEMENTS
530
FORMULATE SIGNALS FOR POINTS
535
SIGNAL NETWORK ELEMENTS
540
SIGNAL POINTS

FIG. 5

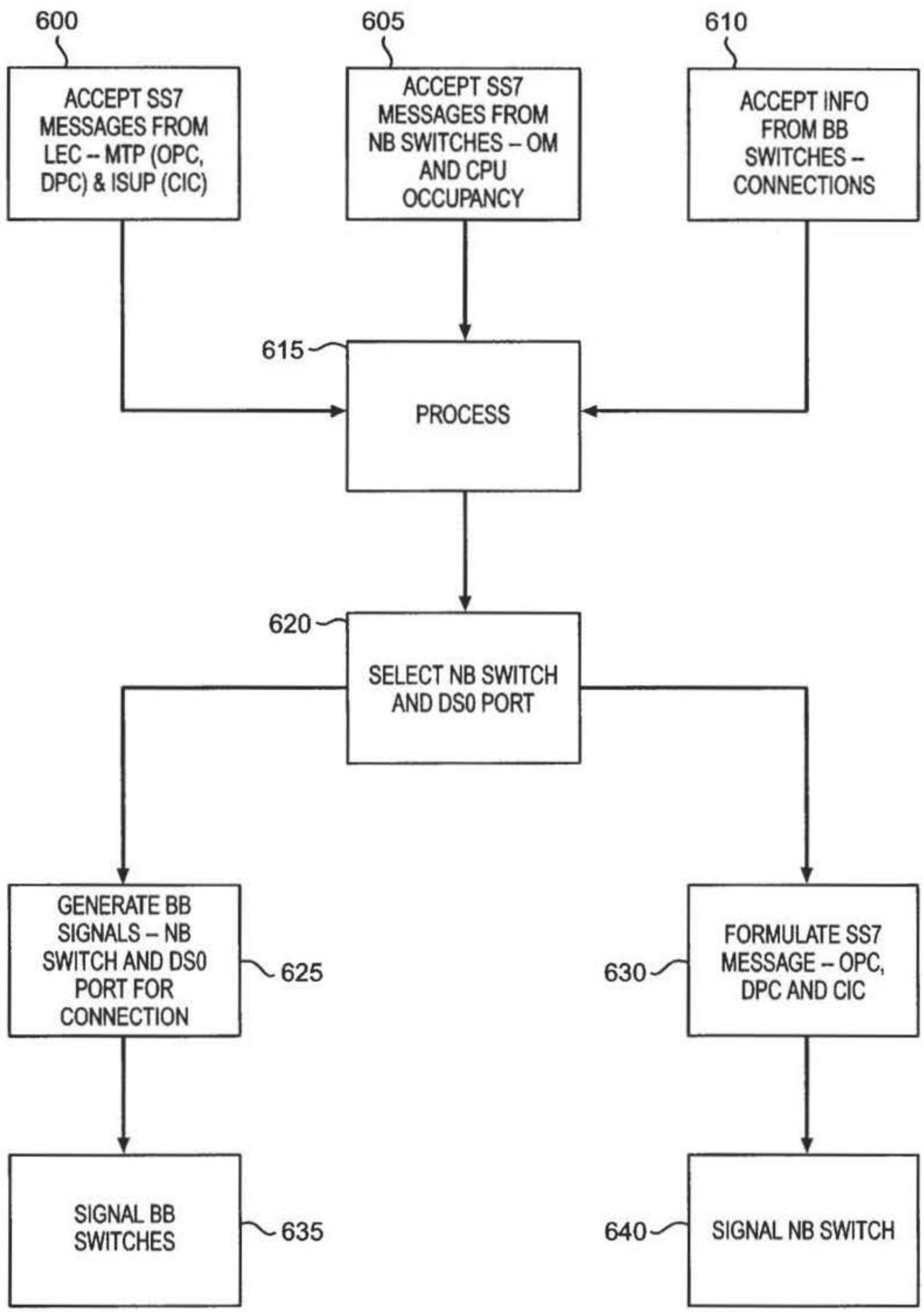
600
ACCEPT SS7 MESSAGES FROM LEC -- MTP (OPC, DPC) & ISUP (CIC)
605
ACCEPT SS7 MESSAGES FROM NB SWITCHES -- OM AND CPU OCCUPANCY
610
ACCEPT INFO FROM BB SWITCHES -- CONNECTIONS
615
PROCESS
620
SELECT NB SWITCH AND DS0 PORT
GENERATE BB SIGNALS -- NB SWITCH AND DS0 PORT FOR CONNECTION
625
630
FORMULATE SS7 MESSAGE -- OPC, DPC AND CIC
SIGNAL BB SWITCHES
635
640
SIGNAL NB SWITCH

FIG. 6

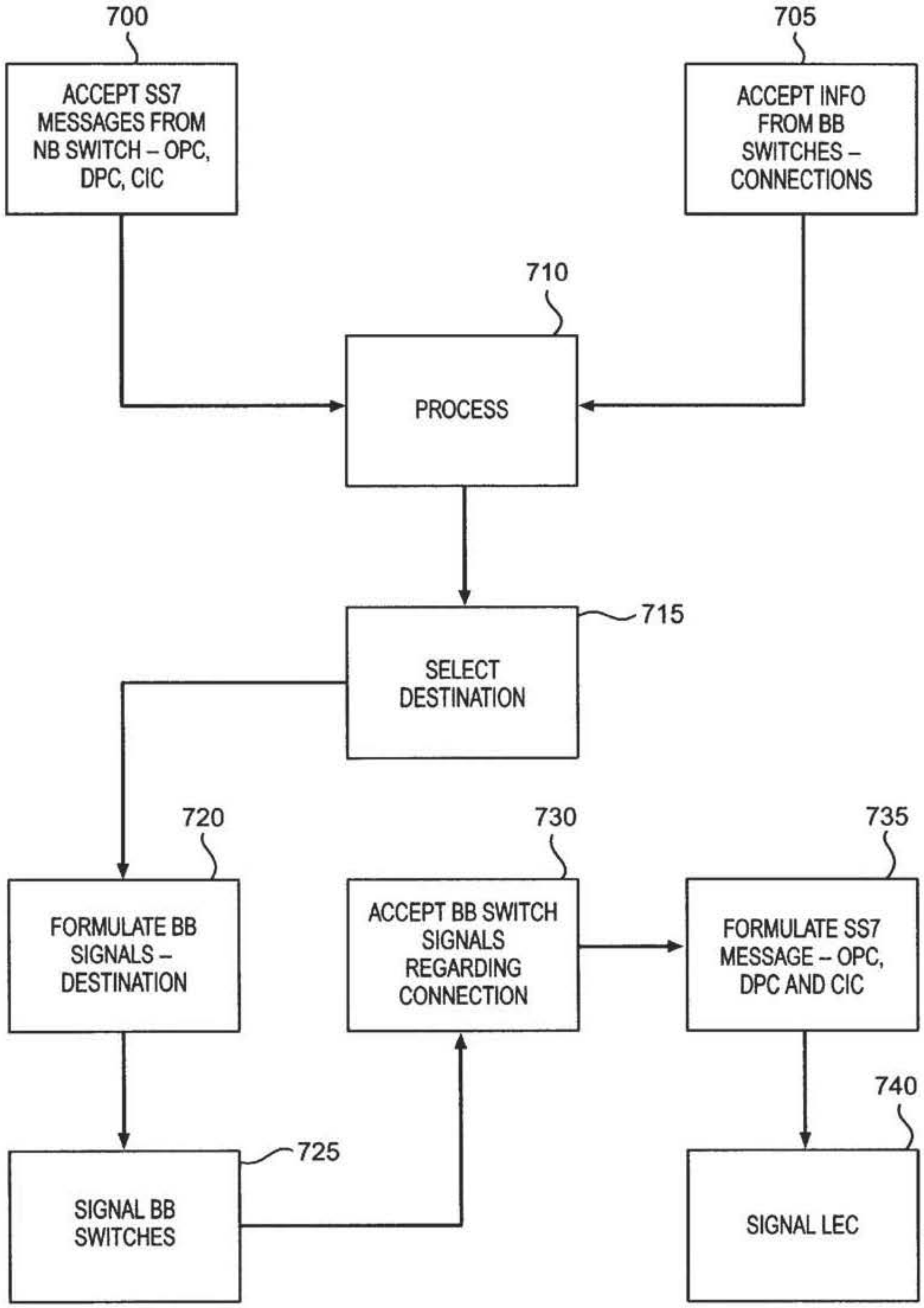
700
ACCEPT SS7 MESSAGES FROM NB SWITCH – OPC, DPC, CIC
705
ACCEPT INFO FROM BB SWITCHES – CONNECTIONS
710
PROCESS
715
SELECT DESTINATION
720
FORMULATE BB SIGNALS – DESTINATION
730
ACCEPT BB SWITCH SIGNALS REGARDING CONNECTION
735
FORMULATE SS7 MESSAGE – OPC, DPC AND CIC
725
SIGNAL BB SWITCHES
740
SIGNAL LEC

FIG. 7

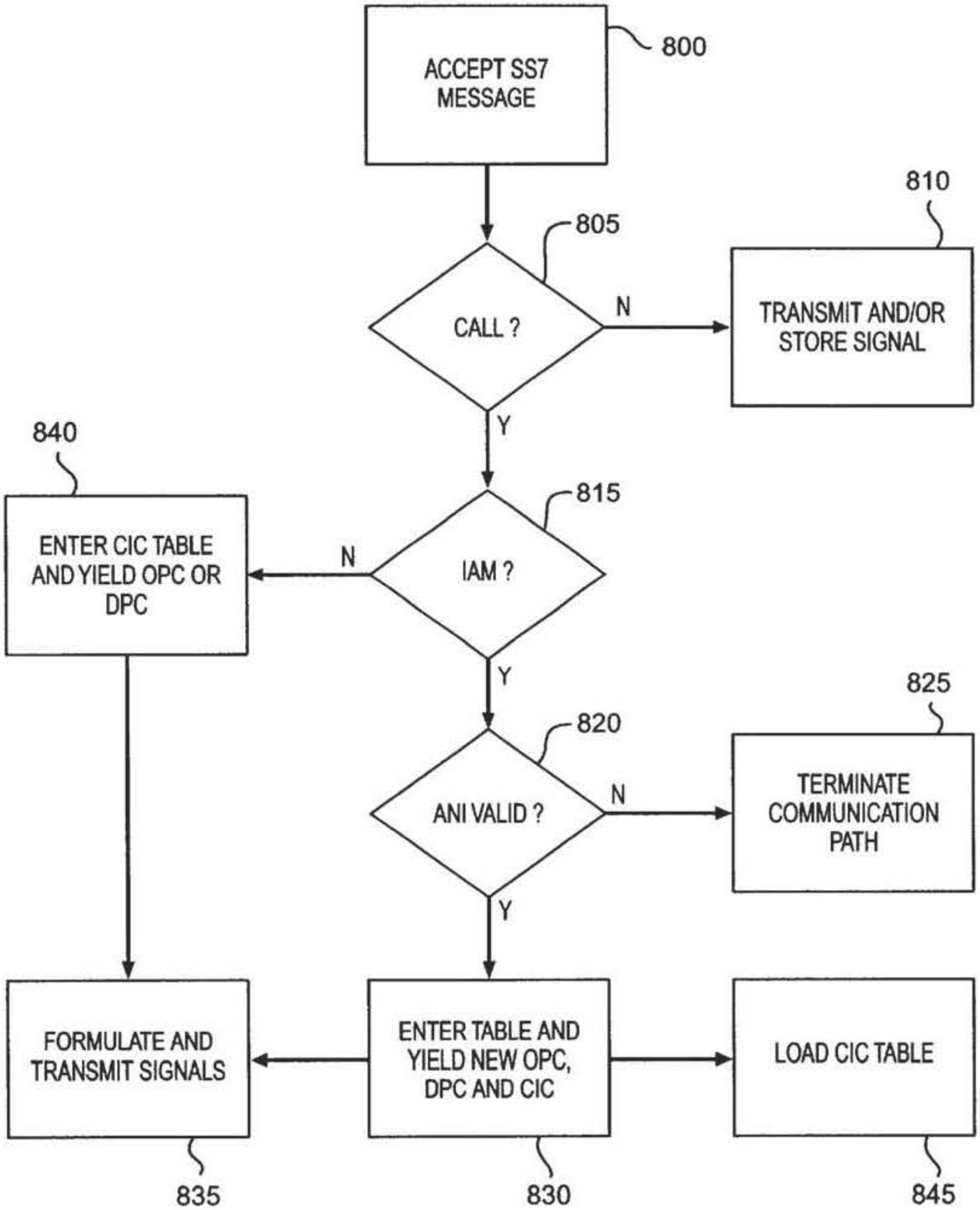
ACCEPT SS7 MESSAGE
800
CALL ?
805
N
TRANSMIT AND/OR STORE SIGNAL
810
Y
IAM ?
815
N
ENTER CIC TABLE AND YIELD OPC OR DPC
840
Y
ANI VALID ?
820
N
TERMINATE COMMUNICATION PATH
825
Y
FORMULATE AND TRANSMIT SIGNALS
835
ENTER TABLE AND YIELD NEW OPC, DPC AND CIC
830
LOAD CIC TABLE
845

FIG. 8

METHOD, SYSTEM AND APPARATUS FOR TELECOMMUNICATIONS CONTROL

RELATED APPLICATIONS

This application is a continuation of application Ser. No. 09/082,040, filed on May 20, 1998, which is a continuation of application Ser. No. 08/568,551, filed on Dec. 7, 1995, now U.S. Pat. No. 5,825,780 which is a continuation of U.S. patent application Ser. No. 08/238,605, filed on May 5, 1994 and now abandoned. U.S. patent application Ser. Nos. 09/082,040, 08/568,551, 08/238,605 and 08/568,551 are hereby incorporated by reference into this application.

FEDERALLY SPONSORED RESEARCH OR DEVELOPMENT

Not Applicable

MICROFICHE APPENDIX

Not Applicable

BACKGROUND OF THE INVENTION

1. Field of the Invention

The invention relates to telecommunications and more specifically to communications control processing in telecommunications signaling.

2. Description of the Prior Art

Telecommunications systems establish a communications path between two or more points to allow the transfer of information between the points. The communications path typically comprises a series of connections between network elements. The network elements are typically switches. Switches provide the primary means where different connections are associated to form the communications path. Communication control is the process of setting up a communications path between the points. Communication control comprises the selection of network elements such as switches or other devices which will form part of the communications path. Communication control also comprises the selection of the connections between the network elements. Together, control also comprises the selection of the connections between the network elements. Together, the network elements and connections which are selected make up the communications path. Typically, a plurality of different network element and connection selections may be possible for any one communications path between points.

Switches control these selections. Switches select the connections that comprise the communications path. Switches also select the network elements which form an actual part of that communications path. By selecting these network elements, a switch is often selecting the next switch that will make further selections. Switches accomplish communication control.

The correspondence between communication control and a communications path is well known in the art. A common method used in communication control is signaling among switches. One method by which a first point requests a communications path to a second point is by signaling a first switch with an off-hook signal followed by dual tone multifrequency (DTMF) signals. The first switch will typically process those signals and will select other network elements such as a second switch. The first switch signals the second switch and establishes a connection between the switches. The second switch then selects the next network element, signals that network element, and establishes a connection to that network element. This process is well known in the art. The connections and signaling thus proceed from switch to switch through the network until a communications path is established between the first and second points.

Some networks transmit signaling information from the switches to other signaling devices. In these cases, the switches typically must be modified through the use of Signaling Point (SP) hardware and software in order to convert the language of the switch into the language used by these other signaling devices. One signaling device is a Service Control Point (SCP). An SCP processes signaling queries from a switch. An SCP only answers a switch query after the switch has become a part of the communications path. SCPs support the communication control which is directed by the switch.

Additionally, signaling may pass through other signaling devices, such as Signal Transfer Points (STPs), which route the signaling. An STP is typically a high-speed packet data switch which reads portions of the signaling information and either discards or routes the information to a network element. The signal routing operation of the STP is based on the signaling information that is specified by the switch. STPs route signaling information, but STPs do not modify or otherwise process the signaling information. An example of the above described system is Signaling System #7 (SS7) technology. Thus, signaling devices only are used to support switches in communication control.

Broadband systems, such as Asynchronous Transfer Mode (ATM) may use extensions of existing SS7 signaling to allow ATM switches to direct communication control. However, broadband systems may also utilize different communication control methods. ATM switches may transfer ATM cells which contain signaling to other ATM switches. As with the other switch types however, ATM switches also perform the dual task of communication control and forming a part of the communications path.

Some switches use API switching which employs remote central processing units (CPUs). These switches only receive switch information from the remote CPUs and not signaling. The protocols used for information transfer between the switch and the remote CPU are proprietary among vendors and are incompatible between the switches of different vendors.

Some digital cross-connect (DCS) equipment employ centralized control systems. These systems, however, only provide relatively static switching fabrics and do not respond to signaling. Instead of establishing connections in response to signaling, DCS cross-connections are established in response to network configuration needs. Network elements and connections are pre-programmed into the network and are not selected in response to signaling from a point outside of the network.

At present, while communication control and the communications path are distinct from one another, both are dependent on the switch. The performance of both of these tasks by switches places limitations on a telecommunications network. One such limitation can be illustrated by one difficulty encountered in combining narrowband networks and broadband networks. Broadband networks are advantageous for data transmission because virtual permanent connections can be mapped through a network and bandwidth allocated on demand. Narrowband switches are advantageous for voice, in part, due to the many features which have been developed in conjunction with these switches. These features benefit both the user and the network through added efficiency and quality. Examples are "800" platforms, billing

systems, and routing systems. However for broadband networks, the development of these features is incomplete and does not provide the functionality of current narrowband features. Unfortunately, narrowband switches do not have the capacity, speed, and multimedia capabilities of broadband switches. The resulting combination is separate overlay networks. Typically, narrowband traffic remains within the narrowband network, and broadband traffic remains within the broadband network.

Any intelligent interface between the two networks would require that signaling information be transmitted between narrowband switches and broadband switches. At present, the ability of these switches to signal each other is limited. These switch limitations create a major obstacle in any attempt to interface the two networks. It would be advantageous if narrowband and broadband networks could interwork through an intelligent interface to establish a communications path between points. At present, the interface between narrowband and broadband networks remains a rigid access pipe between overlay systems.

The reliance on switches to both perform communication control and to form the a part of the communications path results in impediments to developing improved networks. Each time a new network element, such as a broadband switch, is introduced, a telecommunications network may be forced to delay integrating the network element into its network until standardization of signaling and interface protocols are developed for the switches. At present, there is a need for a portion of the communication control processing to be independent of the switches that form a part of the communications path.

SUMMARY

An embodiment of the present invention solves this need by providing a method, system, and apparatus for communication control processing that is located externally to the switches that make the connections. The method includes receiving a first signal into a processor which is located externally to the switches in a network comprised of network elements. The processor selects a network characteristic in response to the first signal. The processor then generates a second signal reflecting the network characteristic and transmits the second signal to at least one network element. This transmission occurs before that network element has applied the first signal. Examples of network characteristics are network elements and connections, but there are others. Examples of signaling are Signaling System #7 or broadband signaling. The processor may also employ information received from the network elements or operational control when making selections. In one embodiment, the method includes receiving the first signal into a network from a point and routing the first signal to the processor.

The present invention also includes a telecommunications processing system which comprises an interface that is external to the switches and is operational to receive and transmit signaling. The processing system also includes a translator that is coupled to the interface and is operational to identify particular information in the received signaling and to generate new signaling based on new information. The processor also includes a processor that is coupled to the translator and is operational to process the identified information from the translator in order to select at least one network characteristic. The processor provides new information to the translator reflecting the selection. The identified information is used in the processor before it is used in the particular network elements that receive the new signaling.

The present invention also includes a telecommunications network comprised of a plurality of network elements wherein at least one network element is a switch, and a plurality of connections between the network elements. The network also includes a processor located externally to the switches which is operable to receive a first signal, to select at least one network characteristic in response to the first signal, and to generate a second signal reflecting the selection. The network also includes a plurality of links between the processor and the network elements which are operable to transmit the second signal to at least one network element before that network element has applied the first signal.

The present invention also includes a telecommunications signaling system for use in conjunction with a plurality of telecommunication switches. This system comprises a plurality of signaling points and a signaling processor. The signaling processor is linked to the signaling points and resides externally to the switches. The signaling processor is operational to process signaling and to generate new signaling information based on the processing. The new signaling is transmitted over the links to multiple signaling points. In one embodiment, the new signaling information is comprised of different signaling messages and the different signaling messages are transmitted to different signaling points.

In another embodiment, a plurality of the signaling points each reside in a different switch and are directly coupled to a processor in the switch that directs a switching matrix in the switch in response to signaling processed by the signaling point. The signaling processor is operational to direct the switching matrixes of multiple switches by signaling multiple signaling points. The signaling processor is also operational to signal multiple points in response to signaling from a single source, and to signal a point in response to signaling from multiple sources.

BRIEF DESCRIPTION OF THE DRAWINGS

These and other features, aspects, and advantages of the present invention will become better understood with regard to the following description, claims, and drawings where:

FIG. **1** is a block diagram of a version of the invention.

FIG. **2** is a block diagram of a version of the invention.

FIG. **3** is a block diagram of a version of the invention.

FIG. **4** is a logic diagram of a version of the invention.

FIG. **5** is a flow diagram of a version of the invention.

FIG. **6** is a flow diagram of a version of the invention.

FIG. **7** is a flow diagram of a version of the invention.

FIG. **8** is a flow diagram of a version of the invention.

DESCRIPTION

Telecommunications systems establish communications paths between points which allow the points to transfer information, such as voice and data, over the communication paths. Typically, telecommunications systems are comprised of network elements and connections. A network element is a telecommunications device such as a switch, server, service control point, service data point, enhanced platform, intelligent peripheral, service node, adjunct processor, network element of a different network, enhanced system or other network related device, server, center or system.

A connection is the media between two network elements that allows the transfer of information. A few examples of connections are: digital T1 lines, OC-3 optical fibers, packet connections, dedicated access lines, microwave

transmission, and cellular radio. As those skilled in the art are aware, connections can be described in a range from general to specific. All of the media between two switches is a general description and might correspond to a virtual path in an ATM system or a trunk groups in a T1 system. An individual circuit between two elements is more specific and might correspond to a virtual channel in an ATM system or a DS0 circuit in a T1 system. Connections can also be described as being logical or physical. Physical connections are electrical-mechanical media. Logical connections are paths which follow physical connections, but are differentiated from one another based on format and protocol. The term "connection" includes this entire range and the meaning varies according to the context in which the term is used. The present invention could make selections encompassing the entire range of connections.

A communications path is the combination of connections and network elements that physically transfers the information between points. A communication path may be point to point, point to multi-point, or multi-point to multi-point. These points, in turn, define the ends of the communications path. Thus, a connection may also be made between a network element and a point outside the network.

Signaling is the transfer of information among points and network elements and is used to establish communications paths. An example is Signaling System #7 (SS7). Signaling is typically transmitted over links, such as 56 kilobit lines. On the block diagrams, signaling is represented by dashed lines and connections are represented by solid lines.

In FIG. 1, Telecommunications System **110** comprises a communication control processor (CCP) **120** and first, second, third, fourth, fifth and sixth network elements, **131**, **132**, **133**, **134**, **135** and **136** respectively. First and second network elements, **131** and **132** respectively, are connected by first connection **141**. First and third network elements, **131** and **133** are connected by both second and third connections, **142** and **143** respectively. First and fifth network elements, **131** and **135** respectively, are connected by fourth connection **144**. Second and fourth network elements, **132** and **134** are connected by fifth connection **145**. The third network element **133** is connected to fourth and sixth network elements, **134** and **136** by sixth and seventh connections, **146** and **147** respectively. Fourth and fifth network elements, **134** and **135** are connected by connection **148**. A first point **170**, which is located outside of the system **110**, is connected to first element **131** by first point connection **171**, and a second point **172** which is also located outside the system **110** is connected to fourth element **134** by second point connection **173**. First and second point, **170** and **172** respectively and first, second, third, fourth, fifth and sixth elements **131**, **132**, **133**, **134**, **135**, and **136** respectively each are linked to CCP **120** by first, second, third, fourth, fifth, sixth, seventh, and eighth links, **191**, **192**, **193**, **194**, **195**, **196**, **197** and **198** respectively.

As those skilled in the art are aware, a system is typically comprised of many more network elements, links, connections and points, but the number is restricted for clarity. Points outside of the network can take many forms, such as customer premises equipment (CPE), telephones, computers, or switches of a separate network system. In addition the system **110**, may take many forms such as international gateways, satellite networks, wireless networks, local exchange carriers (LECs), interexchange carriers (IXCs), transit networks, national networks, personal communicator systems (PCS), virtual private networks, or connection oriented networks such as local area networks (LANs), metropolitan area networks (MANs), wide area networks (WANs) to name some examples.

In operation Telecommunications System **110** is able to accept information from first point **170** and second point **172** and transmit the information over the various network elements and connections which form the communications path. System **110** is also capable of exchanging signaling with first point **170** and second point **172** over the first link **191** and second link **192**.

On a standard call that establishes a communications path from first point **170** to second point **172**, first point **170** will signal Telecommunications System **110** that it requests the communications path. This signaling is directed to CCP **120** over first link **191**. CCP **120** processes the signaling and selects at least one network characteristic in response to the signaling. Network characteristics might be network elements, connections, network codes, applications, or control instructions to name a few examples. The selected network characteristic typically comprises one of a plurality of network elements and/or connections. The CCP **120** generates signaling which is preferably new signaling reflecting the selection. CCP **120** then transmits the signal to at least one of a plurality of network elements before that network element has applied the signal.

In one embodiment, CCP **120** selects the network elements and the connections that comprise the communications path. However, first point **170** will typically seize first point connection **171** contemporaneously with signaling. This initial connection could also be selected by CCP **120** from the available possibilities after the signaling by first point **170**. Assuming first point **170** has seized first point connection **171** to first element **131**, CCP **120** selects one, a plurality, or all of the remaining network elements and connections to further establish a communications path to second point **172**.

CCP **120** determines which element should be connected to first element **131**. CCP **120** could select either second element **132** or third element **133**. If third element **133** is selected, CCP **120** may also select the connection to third element **133** from among second and third connections, **142** and **143** respectively. If third connection **143** is selected, CCP **120** will signal first element **131** over third link **193** to further the communications path to third element **133** over third connection **143**.

CCP **120** may then make further selections to complete the communications path. As the possibilities have been limited for clarity. CCP **120** would make the selections and signal the elements as follows. CCP **120** would signal third element **133** over fifth link **195** to further the communications path to fourth element **134** over sixth connection **146**. CCP **120** would signal fourth element **134** over sixth link **196** to further the communications path to second point **172** over second point connection **173**. CCP **120** would also signal second point **172** over second link **192** of the communications path available through second point connection **173**. In this way, the communications path requested by first point **170** is selected by CCP **120** and signaled to the elements. Throughout this process, CCP **120** may receive status messages and signaling from the elements to support its processing. This status messaging may be transmitted and received over links, connections, or other communication means.

In another embodiment, CCP **120** may select only the network elements and not the connections. The elements would select the connections to use based on the network element selected by CCP **120**. For this embodiment, the main difference from the above example is that CCP **120** would instruct first element **131** to further the communica-

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tions path to third element **133**, but first element **131** would select the actual connection used from among second and third connections, **142** and **143**, respectively. First element **131** may signal CCP **120** over third link **193** of its selection so that CCP **120** may signal third element **133** of the connection over fifth link **195**. In this embodiment, CCP **120** would specify the network elements to the elements, which in turn, would select the connections between those network elements.

There are situations in which the selection of a network element and the selection of a connection signify the same thing. On FIG. **1** for example, instructing first element **131** to use first connection **141** is synonymous with an instruction to connect to second element **132**. This is because the connection inevitably connects to the element. The selection of a connection may effectively select a network element, and the selection of a network element may effectively select a connection (or a group of specific connections) to that network element.

One skilled in the art will recognize that the selection process can be distributed among the CCP and the elements. The CCP might select all the network elements, a portion of the network elements, or none of the network elements leaving the switches to select the remainder. The CCP might select all of the connections, a portion of the connections, or none of the connections, again leaving the elements to select the remainder. The CCP may select combinations of the above options, but the CCP will always select at least one network characteristic.

In another embodiment, first point **170** may want to access a other network elements such as servers, platforms or operator centers. For example, such elements could be located at either fifth or sixth network elements **135**, and **136** respectively. CCP **120** will receive signaling from first point **170** over first link **191** indicating this request, and first point **170** will typically seize first point connection **171** to first element **131**. Again CCP **120** will select network elements. If sixth element **136** is selected, CCP **120** could select a communications path from first element **131** through either second element **132** to fourth element **134** and then to third element **133**, or through a direct connection from first element **131** to third element **133**. If CCP **120** selects the latter, it would signal first element **131** to further the communications path to third element **133**, and it would signal third element **133** to further the communications path to sixth element **136**. As discussed in the above embodiments, CCP **120** may also select the connections, or the elements may be left with that task.

As is known in the art, in-band signaling is typically used in many user to network connections, such as the local loop. This is because only one connection or link is typically provided to the user premises and thus, the signaling must be placed on the actual communications path. The initial network switch typically removes the signaling from the communications path and transfers it to an out-of-band signaling system. The current invention is fully operational in this context. Although the switch may receive the signaling initially, it will only route the signaling to the CCP for processing. Even if in-band signaling is used within the network, the switches could remove signaling from the communications path and route it to the CCP for processing in accord with the present invention.

Thus, preferably the CCP processes signaling before it is applied or processed by the switch such as to select connections or generate queries. Preferably, no or minimal changes are made to the signaling prior to the signaling being received by the CCP so that the CCP receives the signaling in the same format as a switch would receive the signaling. The CCP may also process the signaling in that format. The switches make their selections based on the CCP selections, thus the switch selections clearly occur after the CCP has processed the signaling. As such, the switch may route signaling to the CCP, but the switch does not apply the signaling. Some examples of a switch applying the signaling would be selecting network elements or generating queries for remote devices.

In one of the above embodiments, the switches did not select the network elements and connections, initiate the signaling, or otherwise control the communication. The switches only followed the instructions of the CCP and actually made the connections that furthered the communications path. In one embodiment, the switches were allowed to select the actual connections used, but even these selections were based on CCP selections.

As illustrated above, the CCP allows a telecommunications network to separate communication control from the communications path. In prior systems, the switches would select the network elements and the connections, as well as, actually providing a part of the actual connection. As a result, prior systems are restricted to the communication control capabilities provided by the switches. Prior systems have used remote devices, such as an SCP, to support switch control, but the remote device only answered queries in response to the switches processing of the signal. These remote devices do not process the signaling before the switch had already applied the signaling. By using the CCP, telecommunications systems can control communications independently of the capability of the switches to accomplish both tasks.

FIG. **2** shows a block diagram of another embodiment of the present invention. CCP **250** and network **210** are shown. CCP **250** is a communications control processor. CCP **250** could be integrated into network **210**, but need not be and is shown separately for clarity. Network **210** could be any type of telecommunications network that operates using network elements, signaling, and connections. Examples would be LECs, IXCs, LANs, MANs, WANs, and Cellular Networks, but there are others. Additionally, network **210** could be narrowband, broadband, packet-based, or a hybrid. Network **210** is capable of providing communications paths between points both inside and outside of network **210**. CCP **250** and network **210** are linked by link **214** and are able to signal each other in order to establish these paths.

Additionally, user **220**, and user **230** are shown and are also capable of signaling. Examples of users **220** and **230** might be telephones, computers, or even switches in another telecommunications network. Users **220** and **230** are connected to network **210** by connections **222** and **232** respectively. Users **220** and **230** are linked to CCP **250** by links **224** and **234** respectively. Signaling may be transmitted over links **224** and **234**. If in-band signaling is employed on connections **222** and **232**, network **210** would separate at least a portion of the signaling out-of-band and transmit it to CCP **250** over link **214**.

Also shown are various network elements. As with CCP **250**, these elements could also be integrated into network **210**, but are shown separately for clarity. These network elements are: networks **260**, operator centers **262**, enhanced platforms **264**, video servers **266**, voice servers **268**, and adjunct processors **270**. This is not an exclusive list. Those skilled in the art will recognize these network elements and their functions, as well as the many other types of telecom-

munications devices, such as billing servers, that are applicable in this situation.

Each network element is connected to network **210** by connection **212**. Connection **212** represents several actual connections between the network elements (**260–270**) and different elements in network **210**. One bus-type connection is shown for purposes of clarity, but those skilled in the art are familiar with many actual types of connections to use. Additionally link **256** is shown from CCP **250** to the network elements (**260–270**). Link **256** is similarly represented as a bus-type link for clarity, and multiple links are actually used, although some network elements may not even require links. Link **214** has been simplified for clarity in the same fashion.

In one embodiment, user **220** may desire to establish a communications path to user **230**. CCP **250** would make the appropriate selections and signal the net elements in network **210** as discussed with regard to the embodiments of FIG. **1**. As a result, a communications path would be established from user **220** to user **230** through network **210** and connections **222** and **232**.

In another embodiment, user **220** may desire to access one of the various network elements (**260–270**). User **220** will typically seize connection **222** to network **210** and generate signaling. Both in-band signaling on connection **222** and out-of-band signaling on link **224** would be directed to CCP **250**. By processing the signaling, CCP **250** can select any of the network elements (**260–270**) and control the communications through network **210** and connection **212** to the network elements (**260–270**).

For example, should user **220** desire to connect to a video server and another network, user **220** would signal the request. The signaling would be directed to CCP **250** over link **224**, or over connection **222** and link **214** as discussed above. CCP **250** would process the signaling and make the appropriate selections. CCP **250** would signal network **210** and video servers **266** of its selections. As a result, a communications path would be set-up from user **220** to video servers **266**.

Additionally, CCP **250** would control communications to the other network which is represented by networks **260**. Networks **260** could be any other form of telecommunications network-either public or private. CCP **250** would make the appropriate selections to further the communications path over connection **212** and network **210** to networks **260**. Upon signaling from CCP **250**, the connections comprising the communications path would be made. Networks **260** would also be signalled by CCP **250** over link **256**. As such a communication path is set up from user **230** to video servers **266** and on to networks **260**.

There may also be several devices represented by particular network element shown on FIG. **2**. CCP **250** could also select the particular device to access. For example, take the situation in which voice servers **268** represents 20 individual voice server devices split among three different locations. On each call, CCP **250** could select the actual voice server device which should be used on that call and control the communications through network **210** and connection **212** to the selected device. Alternatively, CCP **250** may only be required to select group of devices, for instance at a particular location, instead of the actual device.

As is known, large telecommunication networks are comprised of numerous network elements, connections, and links. The present invention is suitable for use in this context. FIG. **3** shows a version of the present invention in the context of a large network. Typically, this network would be comprised of several broadband switches, narrowband switches, muxes, signal transfer points (STPs), Service Control Points (SCPs), operator centers, video servers, voice servers, adjunct processors, enhanced services platforms, connections, and links. For purposes of clarity, only a few of these possibilities are shown on FIG. **3**. For the same reason, connections and links are not numbered.

FIG. **3** shows Telecommunications Network **310** which is comprised of STP **340**, STP **345**, CCP **350**, SCP **355**, broadband switches **360**, **362**, **364**, and **366**, interworking units **361** and **365**, narrowband switches **370** and **375**, and muxes **380**, **382**, **384**, and **386**. Aside from CCP **350**, these elements of a large network are familiar to one skilled in the art and examples of the of these network elements are as follows: STP—DSC Communications Megahub; SCP—Tandem CLX; broadband switch—Fore Systems ASX-**100**; narrowband switch—Northern Telecom DMS-**250**; and mux—Digital Link PremisWay with CBR module.

In at least one embodiment, the broadband switches are equipped with signaling interworking units. These units translate SS7 messages into B-ISDN messages. In that event, the CCP could transmit SS7 to the broadband switches which could convert the signals properly. Interworking is discussed in ITU-TS Recommendation Q.2660, "B-ISDN, B-ISUP to N-ISUP Interworking".

When user information passes from a broadband network to a narrowband network, it typically must pass through a mux. Muxes can convert transmitted information back and forth between narrowband and broadband formats. In at least one embodiment, each broadband connection on one side of a mux corresponds to a narrowband connection on the other side of the mux. In this way, the CCP can track connections through the mux. If the communication path is on a given narrowband connection entering the mux, it will exit the mux on its corresponding broadband connection. This correspondence allows the CCP to identify connections on each side of the mux based on the entry connection. Muxes are typically placed at any interface between narrowband and broadband connections.

As long as the connections correspond through the mux, the CCP can track the communication path properly. Alternatively, the connections may not correspond. In that case, signaling links between the muxes and the CCP would be required for the devices to communicate and allow the CCP to track the communication path.

Additionally, Telecommunications Network **310** includes the connections and links which are not numbered. These connections and links are familiar to those skilled in the art. Some examples of possible connections are switched digital lines, satellite links, microwave links, cellular links, and dedicated digital lines, but there are others. The signaling links are typically data links, such as 56 kilobit lines. The signaling may employ SS7,Broadband, C6, C7, CCIS, Q.933, Q.931, T1.607, Q.2931, B-ISUP or other forms of signaling technology. The present invention is fully operational with the many variations which are well known in the art. Additionally, it is also known that a direct link between two devices can be used instead of an STP for signal routing.

Outside of Telecommunications Network **310** are first point **320**, second point **330**, LEC switch **325**, LEC switch **335**, LEC STP **328**, and LEC STP **338**. These devices are shown along with their links and connections. First point **320** is connected to LEC switch **325**. LEC switch **325** is linked to LEC STP **328** which routes signaling from LEC switch **325**. LEC switch **325** is also connected to mux **380** of Telecommunications Network **310**. LEC STP **228** is linked to STP **340** of Telecommunications Network **310**.

STP **340** is linked to STP **345**. The other links are as follows. STPs **340** and **345** are linked to CCP **350**. CCP **350** is linked to interworking units **361** and **365** of broadband switches **360** and **364** respectively. CCP **350** is linked to broadband switches **362** and **366**, and narrowband switch **375**. STP **345** is linked to narrowband switch **370** and SCP **355**. STP **345** is also linked to LEC STP **338** which is linked to LEC switch **335**.

Mux **380** is connected to broadband switch **360**. Broadband switch **360** is connected to broadband switches **362** and **364**. Broadband switch **362** is connected to mux **384** which is connected to narrowband switch **375**. Broadband switch **364** is connected to mux **382** which is connected to narrowband switch **370**. Broadband switches **362** and **364** are both connected to broadband switch **366**. Broadband switch **366** is connected to mux **386** which is connected to LEC switch **335**. LEC switch **335** is connected to second point **330**.

When a call is placed from first point **320** that requires the use of Telecommunications Network **310**, LEC switch **325** will typically seize a connection to Telecommunications Network **310** and generate a signal containing call information. At present, this signal is in SS7 format and the seized connection is a DS0 port. The signal is transmitted to LEC STP **328** which transfers it on to STP **340**. LEC switch **325** also extends the communication path over the seized connection. These LEC components and the process of establishing communication paths between a point, a LEC, and an IXC are familiar to those skilled in the art.

Telecommunications Network **310** accepts the communication path on the narrowband side of mux **380**. The present invention can also accept broadband calls that do not require a mux, but typically, calls from a LEC will be narrowband. Mux **380** converts the call to broadband and places it on the broadband connection that corresponds to the seized connection. The communication path extends to broadband switch **360** through mux **380**.

STP **340** transfers the signal from LEC STP **328** to STP **345** which, in turn, routes the signal to CCP **350**. Also, CCP **350** accepts status messages from the broadband and narrowband switches over standard communications lines, and may query SCP **355** for information. Any suitable database or processor could be used to support CCP **350** queries. CCP **350** uses this information and its own programmed instructions to make communication control selections. For calls that require narrowband switch treatment, CCP **350** will select the narrowband switch.

Preferably, CCP **350** can select any narrowband switch in Telecommunications Network **310**. For example, it may extend the communication path through the broadband network to a narrowband switch across the network for processing, or it may extend the communication path to a narrowband switch connected to the broadband switch that originally accepts the communication path. Additionally, no narrowband switch may be required at all. For clarity, all of the switches representing these possibilities are not shown on FIG. **3**.

CCP **350** will select at least one network characteristic in response to the signaling. Typically, this will be the network elements or connections that will make the communication path. As discussed with regard to the above embodiments, CCP **350** may select only the network elements and allow the switches to select the connections, or the selections can be distributed among the two. For example, CCP **350** may only select some of the network elements and connections and allow the switches to select some of the network elements and connections. CCP **350** might only select the narrowband switches and allow the broadband switches to select the broadband switches that will make the communication path. CCP **350** can also select other network characteristics, such as applications and control instructions.

In one embodiment, CCP **350** will select the narrowband switches to process particular calls and the DS0 ports on those switches which will accept these calls. The broadband switches will select the broadband switches and the broadband connections to the DS0 port. Restricted to the possibilities depicted on FIG. **3**, CCP **350** may select either narrowband switch **370** or narrowband switch **375** to process the call. Assuming CCP **350** selects narrowband switch **370**, it would also select a DS0 port on narrowband switch **370** to accept the connection. CCP **350** would then signal broadband switch **360** through interworking unit **361** to farther the communications path to the selected DS0 port on narrowband switch **370**.

Of the possible routes, broadband switch **360** would be left to select the other broadband switches and connections to use. Assuming the route directly to broadband switch **364** is selected, broadband switch **360** would further the communications path to that switch. Broadband switch **360** would also signal broadband switch **364** of the communication path. Broadband switch **364** would further the communication path to through mux **382** to access the specified DS0 port on narrowband switch **370**. This is accomplished by corresponding the connections through the mux as discussed above. CCP **350** will signal narrowband switch **370** of the incoming communication path. This signal is routed by STP **345**. Narrowband switch **370** will process the call on the specified DS0 port. Typically, this would include billing and routing the call. Narrowband switch **370** may also query SCP **355** to aid in application of services to the call. For example, narrowband switch **370** may retrieve an "800" translation from SCP **355**. As a result of the processing, narrowband switch **370** will switch the call and generate a new signal which may include routing information. The signal is sent to CCP **350** through STP **345**. The communication path is furthered on a new connection back to broadband switch **364** through mux **382**. CCP **350** may use the information in the signal, SCP information, network element information, operational instructions, and/or its own routing logic to make new selections for the call. The network element information and operational instructions could be signalled to CCP **350** or delivered over standard data lines.

In one embodiment, the selection of a network characteristic will include the selection of a network code. Network codes are the logical addresses of network elements. One such code is a destination code that facilitates egress from Telecommunications System **310**. The destination code typically represents a network element that is connected to a LEC switch. Once a destination is selected, CCP **350** will signal broadband switch **364** of its selections and the communication path will be furthered through the broadband network accordingly. In the current example this could be through broadband switch **366** and mux **386**. The communication path would be furthered to the specified port on LEC switch **335**. Typically, this involves the seizure of a connection on the LEC switch by the IXC.

In one embodiment, whenever broadband switch **366** extends a communication path to mux **386**, it is programmed to signal CCP **350** of the broadband connection it has selected. This allows CCP **350** to track the specific DS0 port on the LEC switch that has been seized. CCP **350** would signal LEC switch **335** through STP **345** and LEC STP **338** of the incoming call on the seized DS0 connection. As a

result, LEC switch **335** would further the communication path to second point **330**.

It can be seen from the above disclosure that the present invention allows a telecommunications network to employ a broadband network to make call connections. By using muxes to convert calls and a CCP to analyze signaling, this broadband network remains transparent to the networks of other companies. An example of such a transparent interface is between an interexchange carrier (IXC) network and a local exchange carrier (LEC) network. Similarly the network will be transparent if deployed in only a portion of a single company's network infrastructure.

In the above embodiment, the LEC seizes an IXC DS0 port and signals to an IXC STP. The mux and the CCP convert the call and analyze the signal appropriately. No changes in other existing carrier systems, such as LEC systems, are required.

Additionally the narrowband switch receives the call and signal in its own format and switches the call. Although the switch may "think" the call is routed over a trunk to another narrowband switch, the call actually goes right back to the mux and broadband switch that sent the call. The narrowband switch is used to apply features to the call, i.e. billing, routing, etc. The broadband network is used to make the substantial portion of the call connection. The CCP may use narrowband switch call processing information to make selections.

The CCP performs many functions. In one embodiment, it accepts signaling from a first point or LEC and provides appropriate signals in accord with the communication control selections it has made. These selections are network characteristics. The CCP may select network elements such as switches, servers, or network codes. The CCP may select connections, such as DS0 circuits and ports. The CCP may select particular telecommunications applications to be applied to the communications path. The CCP may select particular control instructions for particular devices. The CCP may also receive information from entities such as SCPs, operational control, or switches to aid in its selections.

The CCP is a processing system, and as such, those skilled in the art are aware that such systems can be housed in a single device or distributed among several devices. Additionally, multiple devices with overlapping capabilities might be desired for purposes of redundancy. The present invention encompasses these variations. One such operational system would be multiple pairs of CCPs located regionally within a telecommunications system. Each machine would be equally capable of communication control. One example of a CCP device would be a Tandem CLX machine configured in accord with this disclosure of the present invention.

A signaling point handles the signaling for a switch. Switches which are used to route calls typically have a signaling point which is directly coupled to a processor in the switch. This processor controls a switching matrix in the switch in response to the signaling processed by the signaling point. Thus, there is typically a one to one correspondence of a signaling point for each switch and matrix.

The CCP is not directly coupled to one switch, one switch processor (CPU), or one switching matrix. In contrast, the CCP has the capability of directing a plurality of switches. Thus, the CCP can direct multiple switch matrixes by signaling multiple signaling points.

It is possible to house the CCP within other telecommunication devices, even switches. Although the CCP can be primarily distinguished from a switch CPU based on physical location, this does not have to be the case. A switch CPU receives information from a signaling point and controls the matrix of a single switch. Some switches distribute the matrix among different physical locations, but the CPU controls each matrix based on information received from a single signaling point This information is not signaling.

In contrast, the CCP receives signaling and has the ability to signal other network elements. It can communicate with multiple signaling points. These signaling points provide information to the switch CPUs which control the switch matrixes. By signaling multiple signaling points, the CCP is able to direct the matrixes of multiple switches based on the signaling and other information the CCP obtains. A CCP is not associated with a single switch matrix. A CCP does not require communication path connections in order to operate.

The main capabilities of one version of a CCP are shown on FIG. **4**. CCP **450** comprises interface **460**, translator **470** operably connected to interface **460**, processor **480** operably connected to translator **470**, and memory **490** operably connected to processor **480**.

CCP **450** functions to physically connect incoming links from other devices such as STPs, switches, SCPs, and operational control systems. Interface **460** is functional to accept the signals off of these links and transfer the signals to translator **470**. Interface **460** is also be able to transfer signaling from translator **470** to the links for transmission.

Translator **470** accepts the signaling from interface **460** and identifies the information in the signaling. Often, this will be done by identifying a known field within a given signaling message. For example, translator **470** might identify the Origination Point Code (OPC), Destination Point Code (DPC), and Circuit Identification Code (CIC) in an SS7 message. Additionally, translator **470** must be able to formulate outgoing signaling and transmit it to interface **460** for transmission. For example, translator **470** might replace the OPC, DPC, and CIC in a given SS7 message and transfer the modified SS7 message to interface **460** for transmission. Translator **510** must be equipped to manage the signaling formats it will encounter. Examples are SS7 and C7.

Processor **480** accepts the signaling information from translator **470** and makes the selections that accomplish communication control. This includes the selection of the network elements and/or connections that make the communications path. Typically, selections are made through table look-ups and SCP queries. Tables are entered and queries are generated based in part on the information identified by translator **470**. The table look-ups and SCP information retrieval yield new signaling information. The new information is transferred to translator **470** for formulation into appropriate signals for transmission. Algorithm solution could also be used to make selections. Processor **480** also handles various, status messages and alarms from the switches and other network elements. Operational control can also be accepted. This information can be used to modify the look-up tables or selection algorithms. Memory **490** is used by processor **480** to store programming, information, and tables.

FIG. **5** shows a flow diagram for the CCP for a version of the present invention. The sequence begins with the CCP receiving different types of information. Box **500** depicts the CCP accepting a signal from a first point. This signal could be in any format, such as SS7 or broadband signaling. The signal may have passed through STPs from a LEC over a signaling link, or it may also be a signal directly provided by an individual user of a network. The signal contains information about the requested communication path. An

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example of such information is the message type which indicates the purpose of the message. Another example of such information is set-up information such as transit network service value, bearer capability, nature of address, calling party category, address presentation restriction status, carrier selection value, charge number, and originating line information, and service code value. Other information might be a network indicator or a service indicator. Those skilled in the art are familiar with these types of information.

Other types of information might also be accessed by the CCP. The network elements, such as switches, may provide the CCP with information as shown inbox **505**. This information allows the CCP to select network elements and connections based on network conditions. Examples of possible types of such information could be management messages, loading, error conditions, alarms, or idle circuits. The CCP might also provide the network elements with information.

Box **510** shows that operational control might be provided. Operational control allows system personnel to program the CCP. An example of such control might be to implement a management decision to retire a particular network element. Operational control would allow the removal that element from the selection process.

The CCP processes the information is has received in box **515**. Processing also entails the use of programmed instructions in the CCP, and might even include the use of information retrieved from a remote database, such as an SCP. The selections are then made as shown in box **520**. These selections specify network characteristics, such as network elements and/or connections. As stated above, The CCP may only select a portion of the network characteristics and allow the points or the switches to select the remainder. It should be pointed out that the information used in processing is not limited to that which is listed, and those skilled in the art will recognize other useful information which may be sent to the CCP.

Once network characteristics are selected, the CCP will signal the points and the applicable network elements of the selections. In box **525**, signals are formulated instructing the network elements of the network characteristics selected. The signals are transmitted to the appropriate network elements in box **535** which will typically result in a communication path through the network elements and connections. Other activity, such as applications and control procedures might be implemented as well. Additionally, in boxes **530** and **540**, signals are formulated and sent to the points. Typically the new signals generated by the CCP are sent to network elements or multiple signaling points. These new signals could be the same, however different signaling is typically sent to the different network elements which may used as part of a communication path.

FIG. **5** represents the sequence that the CCP performs in one embodiment to control communications and establish a communication path from a first point to a second point through network elements and connections. FIGS. **6** and **7** represent a similar sequence, and they are in the context of an Interexchange Carrier (IXC) similar to that depicted in FIG. **3**. The IXC accepts DS0 connections and SS7 signaling from a LEC and employs a broadband system to make the substantial portion of the communication path.

FIG. **6** depicts the flow of the CCP in a version of the present invention when a communication path is established from the LEC to a narrowband switch in the IXC. Box **600** shows that an SS7 message is accepted from the LEC which contains a Message Transfer Part (MTP) and an Integrated Service User Part (ISUP). As those skilled in the art are aware, the MTP contains the Originating Point Code (OPC) and the Destination Point Code (DPC). These point codes define specific signaling points in the network and are typically associated with a switch. As such, the OPC and DPC define a portion of the desired communication path.

When the communication path is extended into the IXC network, the OPC designates the LEC switch that connected to the IXC (**#325** on FIG. **3**). Previously, the DPC has designated the narrowband switch that the LEC would connect to for calls into the IXC. In this embodiment of the present invention, the DPC may designate a particular narrowband switch from the LEC's perspective, but the CCP actually selects the actual narrowband switch used. A mux or a broadband switch accepts the connection from the LEC, not a narrowband switch.

The ISUP contains the Circuit Identification Code (CIC) which designates the DS0 port that the LEC has seized. Previously, this DS0 Port was on a narrowband switch, but in this embodiment of the present invention, the DS0 port is actually on a mux.

Box **605** shows that the CCP may receive status information from the narrowband switches. These messages include Operational Measurements (OM) and CPU Occupancy information. OM includes trunk usage status of the switches which tells the CCP which DS0 ports are available on the narrowband switches. CPU Occupancy tells the CCP of the specific switching load of each narrowband switch. Box **610** shows that the CCP may also accept status information from the broadband switches indicating which connections are idle. This information allows the CCP to specify and balance routing through the broadband switches if desired. As discussed in relation to some of the other embodiments, the broadband switches may be left with that selection.

The CCP processes the information it has received in box **615**. Those skilled in the art are aware of other information which would be useful in this context. As a result of the processing, a narrowband switch and a DS0 port on that switch are typically selected as shown in box **620**. The selected narrowband switch may be close to the LEC or across the broadband network. The CCP determines which narrowband switch will process the call. This makes the narrowband switches virtually interchangeable.

Box **625** shows that a signal indicating these selections is generated and sent to the appropriate broadband switches in box **635**. As discussed, the broadband switches may employ interworking units to handle signaling. Typically, the broadband switches will use internal tables to select broadband connections based on information in the signal from the CCP. Such information might identify the existing extent of the communication path and specify the narrowband switch and the DS0 port on that switch to which the communication path should be extended. The tables would be entered with this information and yield a particular broadband connection to use. Broadband switches further along the communications path could also receive similar signals from the CCP and use similar tables. Alternatively, the broadband switches further along the communications path might only need to enter an internal table using the incoming broadband connection and yield a new broadband connection on which to extend the communications path.

Those skilled in the art are familiar with broadband systems which can accomplish this. Broadband signaling is discussed in the following ITU-TS Recommendations:

Q.2762 "B-ISDN, B-ISDN User Part—General Functions of Messages"; Q.2763 "B-ISDN, B-ISDN User Part—Formats and Codes"; Q.2764 "B-ISDN, B-ISDN User Part—Basic Call Procedures"; Q.2730 "B-ISDN, B-ISDN User Part—Supplementary Services"; Q.2750 "B-ISDN, B-ISDN User Part to DSS2 Interworking Procedures"; and Q.2610 "Usage of Cause and Location in B-ISDN User Part and DSS2".

In at least one embodiment, the broadband switches are equipped with signaling interworking units. These units translate SS7 messages into B-ISDN messages. In that event, the CCP could transmit SS7 to the broadband switches which could convert the signals properly. Interworking is discussed in ITU-TS Recommendation Q.2660, "B-ISDN, B-ISUP to N-ISUP Interworking".

In one embodiment, the broadband switches may select the actual virtual connection that corresponds through a mux to a DS0 port. This DS0 port could be on a narrowband switch or a on a point, such as a LEC switch. In this case, the CCP would not need to select a DS0 port since the broadband switch was in effect doing so. The internal tables of the broadband switches would be programmed to trigger when the particular broadband switch was connecting to particular broadband connections. These connections might be to a DS0 port on a narrowband switch or any specified point. Upon the trigger, the broadband switch would signal the CCP of the broadband connection it has used. The CCP would incorporate this information into the signal it sends to the narrowband switch or specified point. It is preferred that the CCP select the DS0 port on the selected narrowband switches, and that the broadband switches be allowed to select the broadband connection out of the network (through a mux) and signal the CCP of its selection.

The SS7 message from the LEC informed the CCP which DS0 port had been seized (the CIC), on which IXC device (DPC), and by which LEC switch (the OPC). By tracking the DS0 Port through the mux (#**380** on FIG. **3**), the CCP knows which connection the communication path will use to get to the broadband switch (#**360** on FIG. **3**). The CCP provides the broadband network with the proper signaling to extend the communication path from this switch to the selected narrowband switch as shown in box **635**.

Box **630** shows that the CCP formulates an SS7 message based on the selections relating to the narrowband switch. SS7 message formulation methods, such as drop and insert, are known in the art. A new DPC is inserted that will designate the narrowband switch selected by the CCP. A new CIC is inserted that will designate the DS0 port on that switch as selected by the CCP. The SS7 message is sent to the narrowband switch in box **640**.

As such, the communication path is extended from the LEC through the broadband network to the narrow band switch and the narrowband switch is notified of the incoming communication path. Another portion of the SS7 message contains call information including ANI and DNIS. This information was supplied by the LEC and is in the SS7 message sent to the narrowband switch.

The narrowband switch uses this information along with its own programming to switch the call. This switching may include various switching programs and remote databases. The narrowband switch will select a new DPC based on this processing. It will switch the call to a new DS0 port. Previously, this port was connected to a trunk connected to the next narrowband switch in the call routing scenario. However, in the present invention, the DS0 port is connected through a mux to broadband switch. The narrowband switch will place the new DPC in an SS7 message. Along with the new DPC, a new CIC identifying the new DS0 circuit, and a new OPC designating the narrowband switch itself is placed in the SS7 message and sent to the CCP.

FIG. **7** shows the flow of the CCP when extending a communication path from the selected narrowband switch to a point outside of the IXC in one embodiment of the present invention. The SS7 message generated by the narrowband switch after processing the call is received by the CCP in box **700**. In it, the CIC designates the DS0 port the communications path extends from on the narrowband switch. Because this port is connected to a mux with corresponding connections, the CCP can determine which connection the communication path uses to extend back to the broadband switch.

The CCP may also receive status information from the broadband switches as shown in box **705**. This information allows the CCP to select broadband connections if desired. As discussed, the broadband switches may make these selections. Typically, the broadband switches will use internal tables to select broadband connections based on information in the signal from the CCP. Such information might specify destination code. The destination code might correspond to a terminating switch or a LEC switch to which the communication path should be extended.

As shown in box **710**, the CCP applies processing and selects the appropriate destination for the broadband network to extend the communication path to as shown in box **715**. The CCP may use the new DPC provided by the narrowband switch to identify the destination for the broadband communication path.

In box **720**, signals. are generated reflecting this selection and sent to the appropriate broadband switches in box **725**. As discussed, the broadband switch may trigger and signal the CCP when it uses particular connections. This would occur for a connection through a mux to a LEC switch. This signal is accepted by the CCP in box **730** and is used to identify the DS0 port. An SS7 message is formulated in box **735** and in it the CIC will identify this DS0 connection on the LEC switch (#**335** on FIG. **3**). Alternatively, this DS0 port may have been selected by the CCP and signalled to the broadband switch. The LEC is signalled in box **740**

From FIGS. **6** and **7**, a sequence is shown that demonstrates the procedures that the CCP can follow to accept signaling from the LEC and make selections that control communications through the IXC network. The CCP must produce signals to implement its selections and transmit them to the applicable network elements. The CCP is able to use the outing, billing, and service features of a narrowband switch, but is still is able to employ a broadband network to make a substantial part of the communications path.

FIG. **8** is a flow diagram of CCP signal processing in one embodiment of the invention. Box **800** shows that an SS7 signal has been accepted by the CCP. Box **805** shows that the CCP determines the message type. If the message is not a call message, it is routed or used to update the CCP memory if appropriate as shown in box **810**. Non-call messages are familiar to those skilled in the art with examples being filler or management messages. If the SS7 message is a call message, it is examined to determine if it is an initial address message (IAM) in box **815**. Call messages and IAMs are familiar to those skilled in the art. If it is an IAM, the information provided by automatic number identification (ANI) is used to validate the call in box **820**. ANI validation is accomplished with a table look-up and is well known. If invalid, the communication path is terminated as shown in box **825**.

Once an IAM with a valid ANI is determined, a table is entered which yields an OPC—DPC—CIC combination as shown in box **830**. One skilled in the art will recognize that such a table can take many forms. One example is to set up a table with every combination of OPC—DPC—CIC on one side. The table is entered using OPC—DPC—CIC of the incoming IAM message. After entry through these fields is accomplished, the table yields a new OPC—DPC—CIC which can be formulated into the SS7 message and sent to the switching network as shown in box **835**. The switching network is capable of using this information to make connections.

Once the IAM signal has been processed, subsequent SS7 messaging, can be processed by a separate CIC look-up table entered using the CIC as shown in box **840**. Subsequent messages, such as address complete, answer, release, and release complete can be processed by entering the CIC table using the CIC in these non-IAM signals. For signals directed to the first point, the table yields the original OPC which is used as the DPC. Additionally, subsequent. messages from the first point enter the CIC table using their CIC, and the table yields the DPC previously selected by the CCP for the IAM processing. The CIC table is constantly updated to reflect current processing as shown in box **845**. In this way, the CCP is able to efficiently process non-IAMs because theses signals only need to reflect the results of previous IAM selections.

There can be exceptions to the use of the CIC table for non-IAM call messages. One example would be if a new connection is allowed after release. In that case, the IAM procedures would be followed.

Those skilled in the art will recognize the numerous factors that can be used to design and load the tables. Different OPC—DPC—CIC combinations can be yielded by the tables based on many factors. Some of these factors are: called number, time of day, CPU occupancy, switch status, trunk status, automatic call distribution, operational control, error conditions, network alarms, user requests, and network element status.

For example, if a certain switch must be taken out of service, it is merely replaced in the table with suitable substitutes. The switch is then effectively taken out of service because it is no longer selected. If the CPU loading of a certain switch reaches a threshold, its presence in the tables can be diminished and distributed to other switches.

In another example, if it is busy hour in region A, the tables may yield network elements in region B to process the call. This can be accomplished by adding an area code or a dialed number entry, and time of day entry in the table. For calls placed from an OPC in region A to an area code or dialed number in region B, a narrowband switch in region B could be selected. As such, the DPC yielded by the table during this time frame should reflect a region B narrowband switch. Also, for calls placed from an OPC in region B to an area code or dialed number in region A, the tables should provide the DPC of a region B narrowband switch.

In a preferred embodiment, IAM messages would cause the CCP to query an SCP, data element, or database for support. The SCP would answer the query by using tables as discussed above. The answers would be sent to the CCP and used to formulate signaling. Subsequent messages would be then handled by the CCP using the CIC table. An example of such support would be for the CCP to query the SCP in response to receiving an IAM message. The query may include the OPC, CIC, DPC, and the area code, or dialed number. The SCP could use this information to select network characteristics and avoid busy regions as described in the above busy region example. For example, the SCP would maintain tables for OPC—dialed area code—time of day combinations that would yield a new DPC and CIC. This assumes that busy hour in a region corresponds to time of day, but other factors and yields could also be involved.

In one embodiment, the dialed number or area code could be used to select the new DPC, and time stamps could be placed in the signaling. This might entail tables with OPC—dialed area code entries that yield a new DPC and CIC. In this case, narrowband switches may not even be needed since billing can be applied using the time stamps. The CCP could then route the call directly using only the broadband network. This is especially relevant for POTS calls in which only an area code entry would need to be added to the tables.

As discussed above, often a connection will consist of two separate connection procedures. One connection procedure will be from the origination to a selected network element. The other connection procedure will be from the selected network element to the destination. Also it has been disclosed that the CCP could actually be discreet machines located regionally. In these cases, the CCP device processing the first connection procedure could be located in the origination region, and the CCP device that processes the second connection procedure could be located in the region of the selected network element.

The present invention offers the advantage of separating at least a portion of the communication control from the communication path. By examining and translating signaling independently of the communication path, multiple switches and network elements can be connected in the optimum way. Communications paths are no longer limited to only the connections the switches can control. Networks do not have to wait for standardization among signaling and interface protocols.

The present invention allows for the selection of network characteristics, such as network elements and connections, before switches process or apply the signaling. The switches are not required to have a capability either to make selections or to signal each other. The switches only make connections as directed by the CCP which signals in each switches own signaling format. Various criteria can be used for the selections in the CCP, such as time of day, load balancing, or invalid ANI. As such, the present invention allows for a smooth transition from narrowband to broadband networks. It also allows for the selection of network elements, such as servers and enhanced services platforms.

The present invention represents a fundamental and powerful departure from previous telecommunications technology. By separating the communications path from communication control, the CCP can utilize different networks, and network devices, intelligently. Previously telecommunications systems have been dependent on the switches to accomplish communication control. As such, telecommunications systems have had to wait for the switches to develop communication control before new technology could be implemented. Switches have always been required to physically make connections and provide control over which connections are required. Switch capabilities have not been able to keep up with all of the network possibilities available. The result is a limited system.

Switches have been given support in this dual task. SCPs, STPs, and adjunct processors provide support for communication control. However, these devices only support the switches communication control, and the switch remains essential to communication control. This dependence has created a bottleneck given the available network possibilities.

One advantage of the present invention is that it allows narrowband switches be used interchangeably in a narrowband/broadband hybrid network. Any narrowband switch may be taken out of service without re-routing traffic and changing routing logic in each switch. The CCP is simply programmed not to select the given narrowband switch for call processing. The CCP will route calls over the broadband network to another narrowband switch. This flexibility also allows the telecommunications network to easily transfer narrowband switch loads.

An important advantage of this system is that both the advantages of broadband and narrowband systems are utilized. The transmission capabilities of a broadband network are coupled with the narrowband network's ability to apply features. For example, the CCP can use the broadband network to substantially make the call connection from origination to destination. The CCP diverts the traffic to the. narrowband network for processing. The narrowband network can apply features, such as billing and routing. Once processed, the traffic is directed back to the broadband network for completion of the connection. The CCP can then use the routing information generated by the narrow band system to route the traffic through the broadband system to the destination. As a result, the telecommunications system does not have to develop a billing or "800" routing feature for its broadband network. This can be accomplished because the CCP allows both networks to work together intelligently.

Another advantage of the present invention is the elimination of a substantial percentage of the DS0 ports required on the existing narrowband switches. In the current architectures, narrowband switches are interconnected to each other. A substantial percentage of the switch ports are taken up by these connections. By eliminating the need for the switches to connect to each other, these ports can be eliminated. Each narrowband switch is only connected to the broadband system. This architecture requires fewer ports per switch. By load balancing with the CCP, the number of ports required on busy switches can be reduced. The architecture in the present invention does require additional broadband ports, but these can be added at a significant cost saving versus narrowband ports.

Additionally, the narrowband switches no longer signal each other since all signaling is directed to the CCP. This concentration accounts for a reduction in required signaling link ports. This reduction possibly could result in the elimination of STPs.

As mentioned above, an advantage of the present invention is its ability to treat narrowband switches, or groups of narrowband switches, interchangeably. The CCP can pick any narrowband switch to process a particular call. This allows the network to pull narrowband switches out of service without taking extreme measures. In turn, this simplifies the introduction of new services into the network. A switch can be pulled out of service simply by instructing the CCP to stop selecting it. The switch can be re-programmed and put back into service. Then the next switch can then be updated in the same manner until all of the switches are implementing the new service. Switches can also be easily pulled to test developing applications.

This narrowband switch flexibility also allows the CCP to balance switch loads through the network during peak times, or during mass calling events. This eliminates the need to implement complex and expensive load balancing features in the narrowband network. Instead of programming the several switches to balance among themselves, one command to the CCP can achieve this.

Another advantage is the reduction in call set-up time. Most large networks require that a call pass through more than two narrowband switches arranged in a hierarchical fashion. One large network employs a flat architecture in which all narrowband switches are interconnected, but this still requires that the call pass through two narrowband switches. In the present invention, only one narrowband switch is required for each call. The use of broadband switches to set-up and complete the call represents significant time savings.

What is claimed is:

1. A method of operating a processing system to control a packet communication system for a user communication, the method comprising:

receiving a signaling message for the user communication from a narrowband communication system into the processing system;

processing the signaling message to select a network code that identifies a network element to provide egress from the packet communication system for the user communication;

generating a control message indicating the network code;

transferring the control message from the processing system to the packet communication system

receiving the user communication in the packet communication system and using the network code to route the user communication through the packet communication system to the network element; and

transferring the user communication from the network element to provide egress from the packet communication system.

2. The method of claim **1** wherein processing the signaling message comprises processing an Initial Address Message (IAM).

3. The method of claim **1** wherein processing the signaling message comprises processing a Signaling System #7 (SS7) message.

4. The method of claim **1** wherein processing the signaling message comprises processing a Q.931 message.

5. The method of claim **1** wherein processing the signaling message comprises processing in-band signaling.

6. The method of claim **1** wherein processing the signaling message to select the network code comprises processing caller number information in the signaling message.

7. The method of claim **1** wherein processing the signaling message to select the network code comprises processing called number information in the signaling message.

8. The method of claim **1** wherein processing the signaling message to select the network code comprises processing a point code in the signaling message.

9. The method of claim **1** wherein processing the signaling message to select the network code comprises processing a circuit identification code in the signaling message.

10. The method of claim **1** wherein processing the signaling message to select the network code comprises generating and transferring a query to a service control point and receiving and processing a response from the service control point.

11. The method of claim **1** further comprising processing geographic information to select the network code.

12. The method of claim **1** further comprising processing load balancing information to select the network code.

13. The method of claim **1** further comprising processing time of day information to select the network code.

14. The method of claim **1** further comprising processing a network alarm to select the network code.

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15. The method of claim **1** wherein the network code comprises a logical address of the network element.

16. The method of claim **1** further comprising processing the signaling message to select a DS0 connection to provide the egress from the packet communication system.

17. The method of claim **1** further comprising processing the signaling message to select a wireless connection to provide the egress from the packet communication system.

18. The method of claim **1** wherein the network element comprises a switch.

19. The method of claim **1** wherein the network element comprises a multiplexer.

20. The method of claim **1** wherein the network element comprises a server.

21. The method of claim **1** wherein the network element comprises a service platform.

22. The method of claim **1** wherein the user communication comprises voice.

23. The method of claim **1** wherein the processing system is external to any communication switches.

24. A method of operating a processing system to control a packet communication system for a user communication, the method comprising:

selecting a network code that identifies a network element to provide egress for the user communication from the packet communication system to a narrowband communication system;

generating a control message indicating the network code and transferring the control message from the processing system to the packet communication system; and

generating a signaling message for the user communication and transferring the signaling message from the processing system to the narrowband communication system;

receiving the user communication in the packet communication system and using the network code to route the user communication through the packet communication system to the network element; and

transferring the user communication from the network element to the narrowband communication system to provide egress from the the packet communication system.

25. The method of claim **24** wherein generating and transferring the signaling message comprises generating and transferring an Initial Address Message (IAM).

26. The method of claim **24** wherein generating and transferring the signaling message comprises generating and transferring a Signaling System #7 (SS7)message.

27. The method of claim **24** wherein generating and transferring the signaling message comprises generating and transferring a Q.931 message.

28. The method of claim **24** wherein generating and transferring the signaling message comprises generating and transferring in-band signaling.

29. The method of claim **24** wherein the network code comprises a logical address of the network element.

30. The method of claim **24** further comprising selecting a DS0 connection to provide the egress from the packet communication system and identifying the DS0 in the signaling message.

31. The method of claim **24** further comprising selecting a wireless connection to provide the egress from the packet communication system and identifying the wireless message in the signaling message.

32. The method of claim **24** wherein the network element comprises a switch.

33. The method of claim **24** wherein the network element comprises a multiplexer.

34. The method of claim **24** wherein the network element comprises a server.

35. The method of claim **24** wherein the network element comprises a service platform.

36. The method of claim **24** wherein the user communication comprises voice.

37. The method of claim **24** wherein the user communication comprises data.

38. The method of claim **24** wherein the processing system is external to any communication switches.

* * * * *

EXHIBIT H

US006298064B1

(12) **United States Patent**
Christie

(10) **Patent No.: US 6,298,064 B1**
(45) **Date of Patent: Oct. 2, 2001**

(54) **BROADBAND TELECOMMUNICATIONS SYSTEM**

(75) Inventor: **Joseph Michael Christie**, San Bruno, CA (US)

(73) Assignee: **Sprint Communications Company, L. P.**, Kansas City, MO (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

This patent is subject to a terminal disclaimer.

(21) Appl. No.: **09/504,408**

(22) Filed: **Feb. 15, 2000**

Related U.S. Application Data

(63) Continuation of application No. 09/353,401, filed on Jul. 15, 1999, which is a continuation of application No. 08/525,897, filed on Sep. 8, 1995, now Pat. No. 5,991,301, which is a continuation-in-part of application No. 08/568,551, filed on Dec. 7, 1995, now Pat. No. 5,825,780, which is a continuation of application No. 08/238,605, filed on May 5, 1994, now abandoned.

(51) **Int. Cl.**[7] **H04L 12/56**; H04L 12/28

(52) **U.S. Cl.** **370/410**; 370/466

(58) **Field of Search** 370/385, 386, 370/389, 395, 396, 397, 398, 399, 409, 410, 422, 426, 466, 467, 465; 379/229, 230, 231

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Minoli, Daniel/DVI Communications, Inc./Stevens Institute of Technology and Dobrowski, George/Bell Communications Research (Bellcore), Principles Of Signaling For Cell Relay And Frame Relay © pp. 1–2, 5–6 and 229, 1994.

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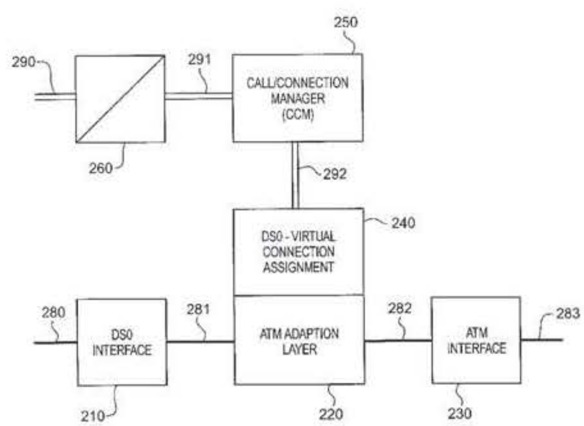
Primary Examiner—Ajit Patel
(74) *Attorney, Agent, or Firm*—Harley R. Ball; Steven J. Funk

(57) **ABSTRACT**

The invention is a system for providing virtual connections through an ATM interworking multiplexer on a call-by-call basis. A signaling processor receives signaling for a call and selects the virtual connection for the call. The signaling processor generates new signaling that identifies the selection and transfers the new signaling to the ATM interworking multiplexer that accepted the access connection for the call. The multiplexer converts user information from the access connection into ATM cells for transmission over the virtual connection in accord with the new signaling.

68 Claims, 12 Drawing Sheets



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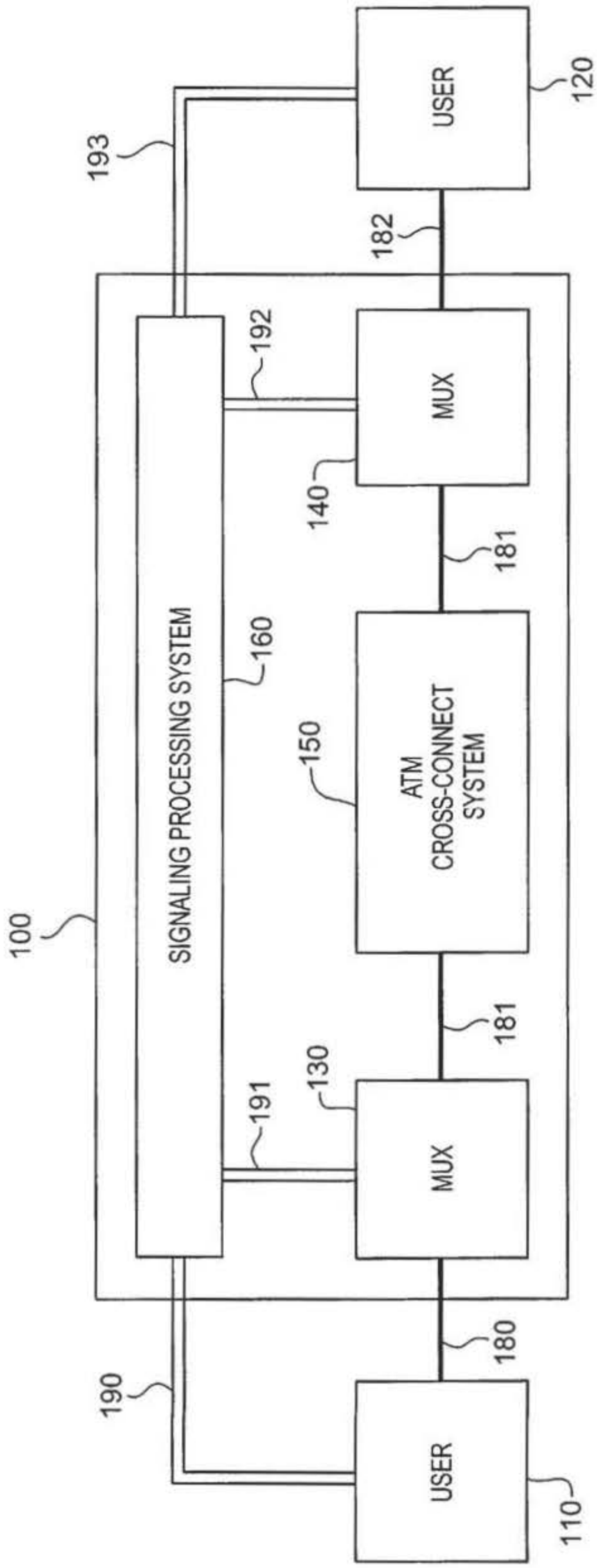
USER
120
193
182
192
MUX
140
181
SIGNALING PROCESSING SYSTEM
160
150
ATM
CROSS-CONNECT
SYSTEM
100
181
130
191
MUX
180
190
USER
110

FIG. 1

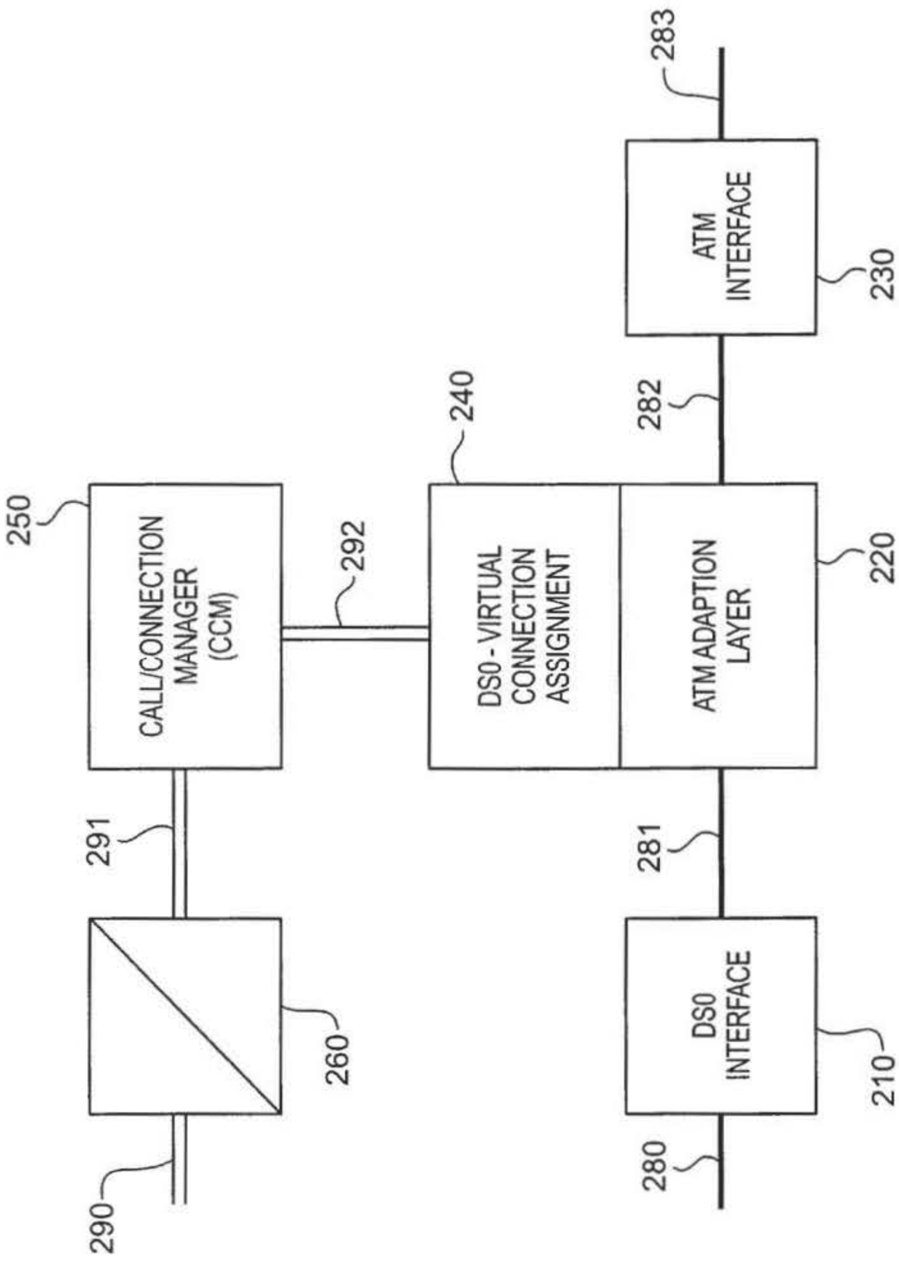
CALL/CONNECTION MANAGER (CCM)
DS0 - VIRTUAL CONNECTION ASSIGNMENT
ATM ADAPTION LAYER
ATM INTERFACE
DS0 INTERFACE
210
220
230
240
250
260
280
281
282
283
290
291
292

FIG. 2

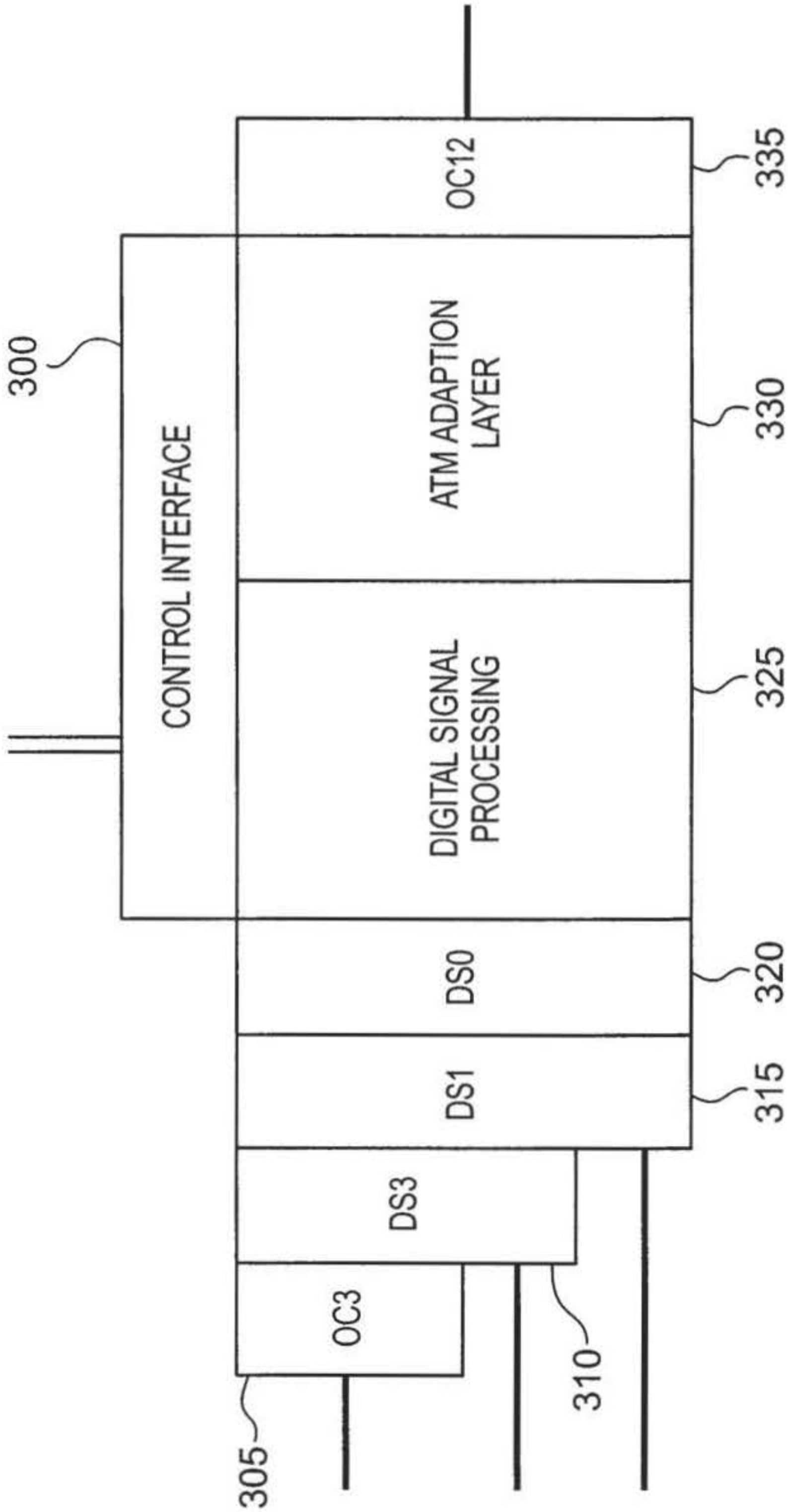
300
CONTROL INTERFACE
OC12
ATM ADAPTION LAYER
DIGITAL SIGNAL PROCESSING
DS0
DS1
DS3
OC3
305
310
315
320
325
330
335

FIG. 3

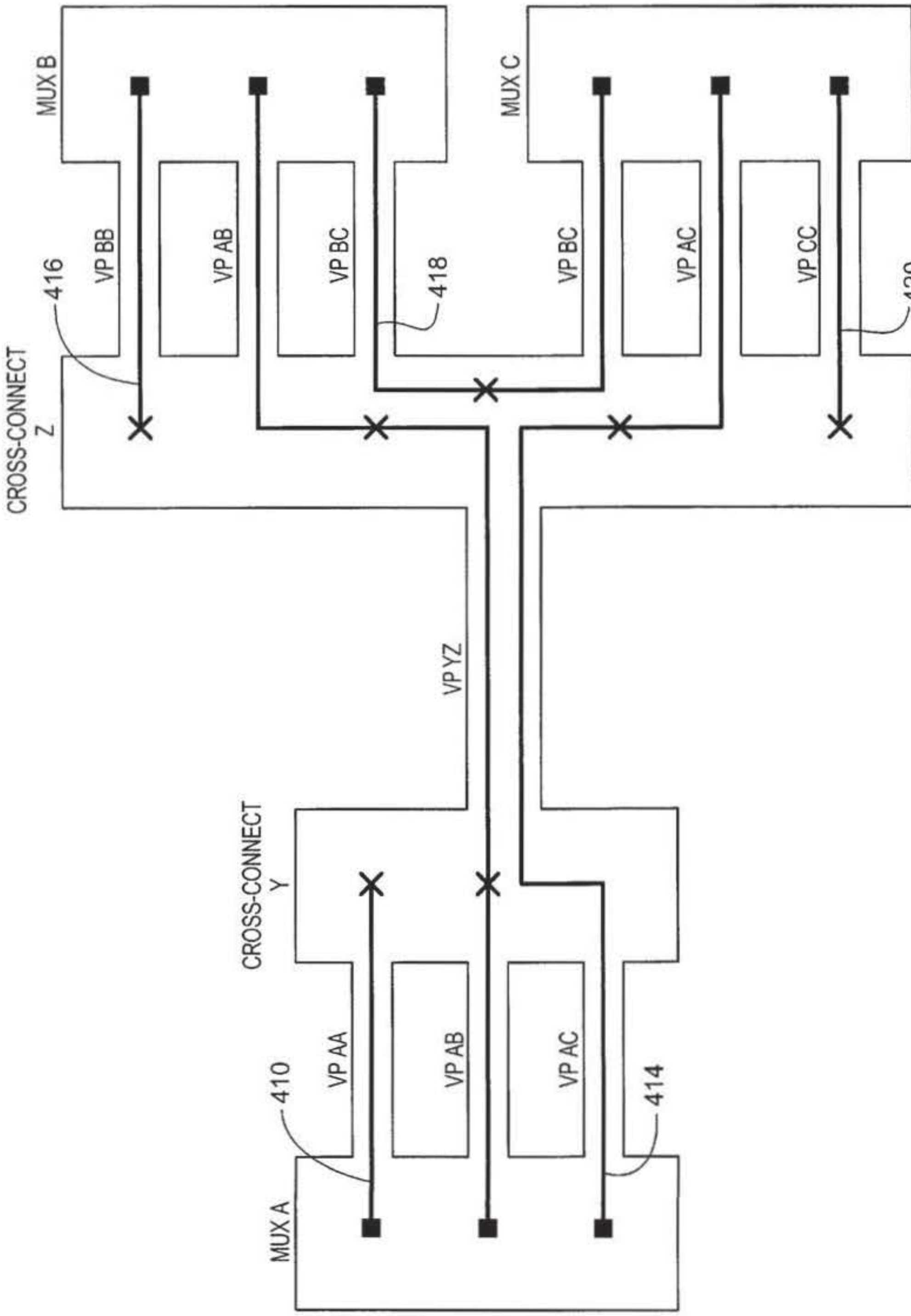
MUX B
MUX C
VP BB
VP AB
VP BC
VP BC
VP AC
VP CC
416
418
420
CROSS-CONNECT Z
VP YZ
CROSS-CONNECT Y
VP AA
VP AB
VP AC
410
414
MUX A

FIG. 4

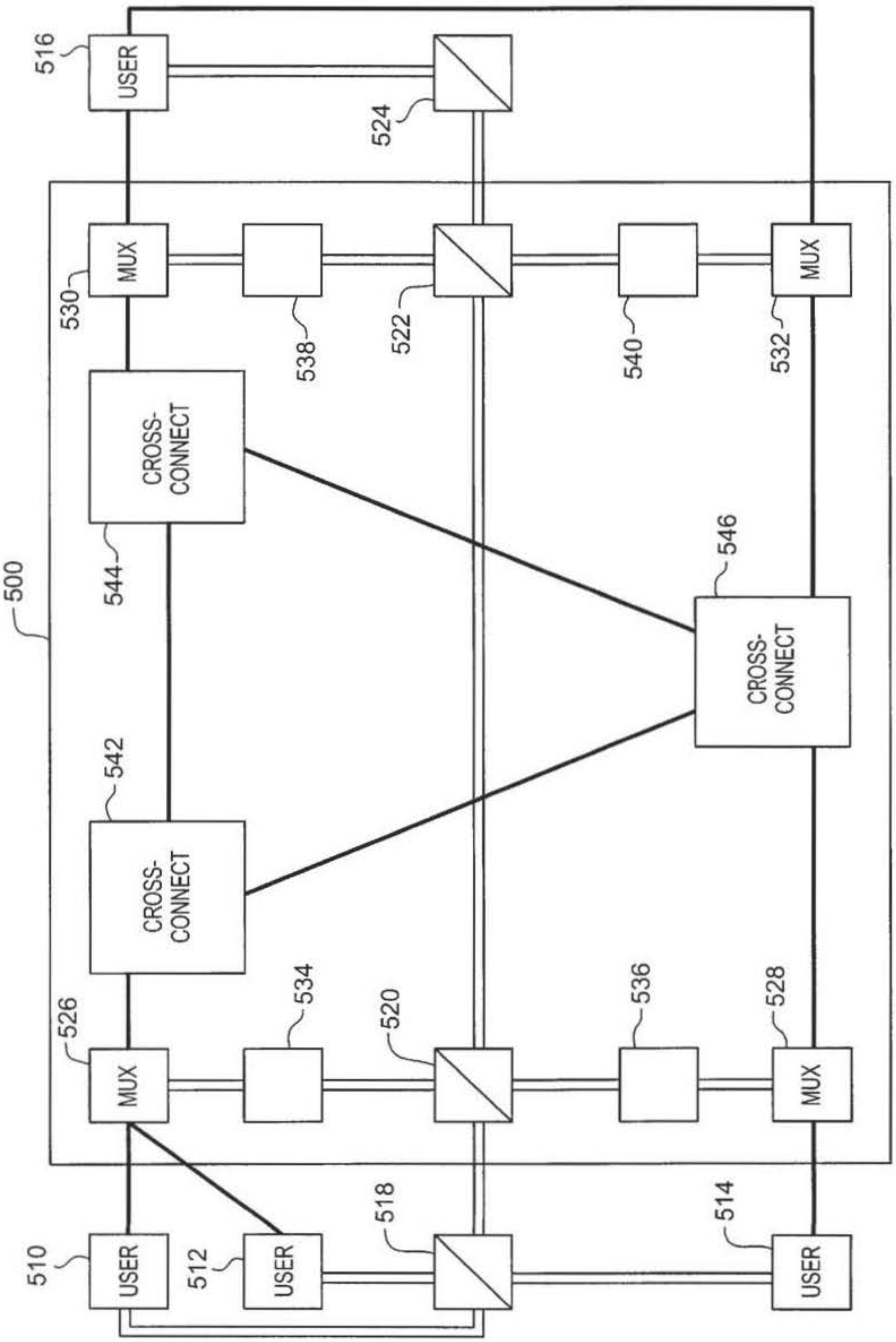
516
USER
524
530
MUX
538
522
540
MUX
532
500
CROSS-CONNECT
544
546
CROSS-CONNECT
542
CROSS-CONNECT
526
MUX
534
520
536
528
MUX
510
USER
512
USER
518
514
USER

FIG. 5

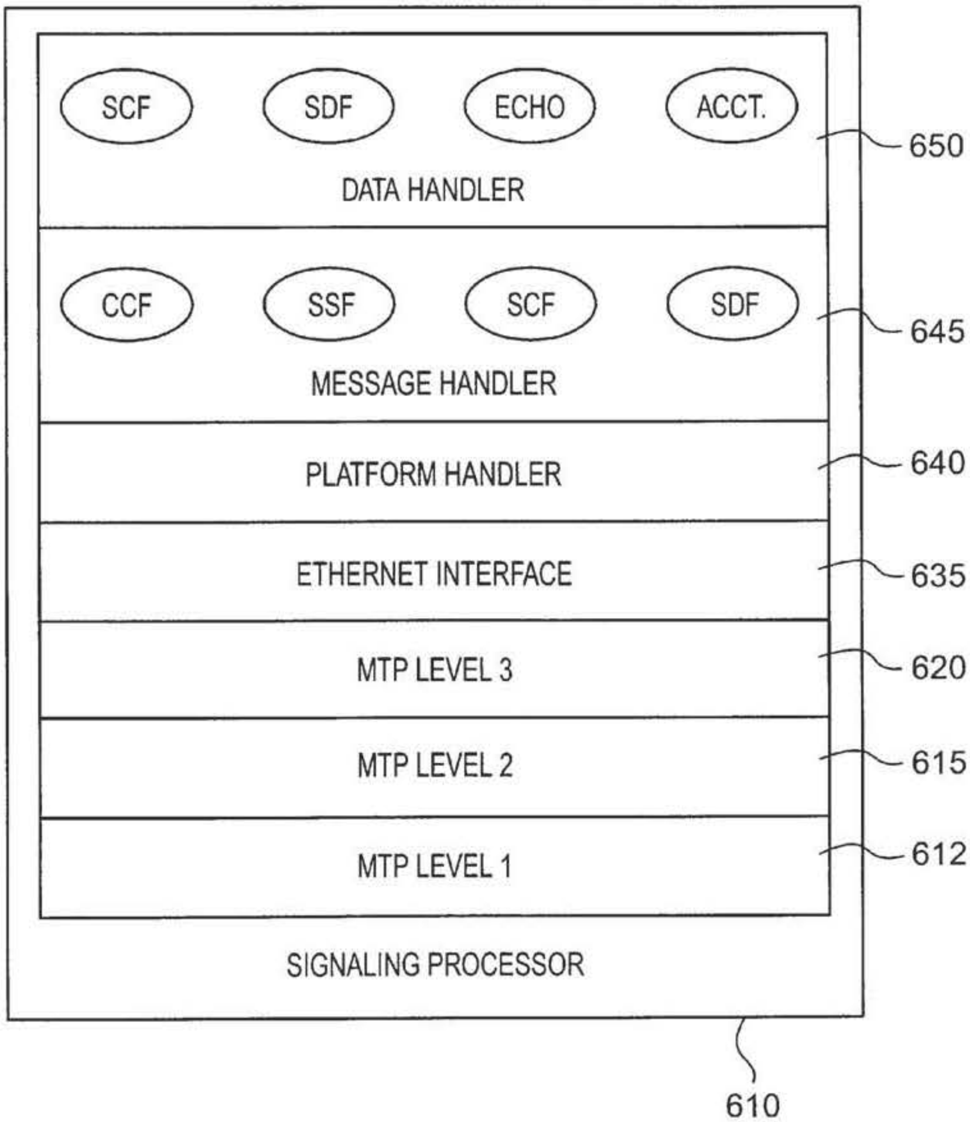
SCF
SDF
ECHO
ACCT.
DATA HANDLER
650
CCF
SSF
SCF
SDF
MESSAGE HANDLER
645
PLATFORM HANDLER
640
ETHERNET INTERFACE
635
MTP LEVEL 3
620
MTP LEVEL 2
615
MTP LEVEL 1
612
SIGNALING PROCESSOR
610

FIG. 6

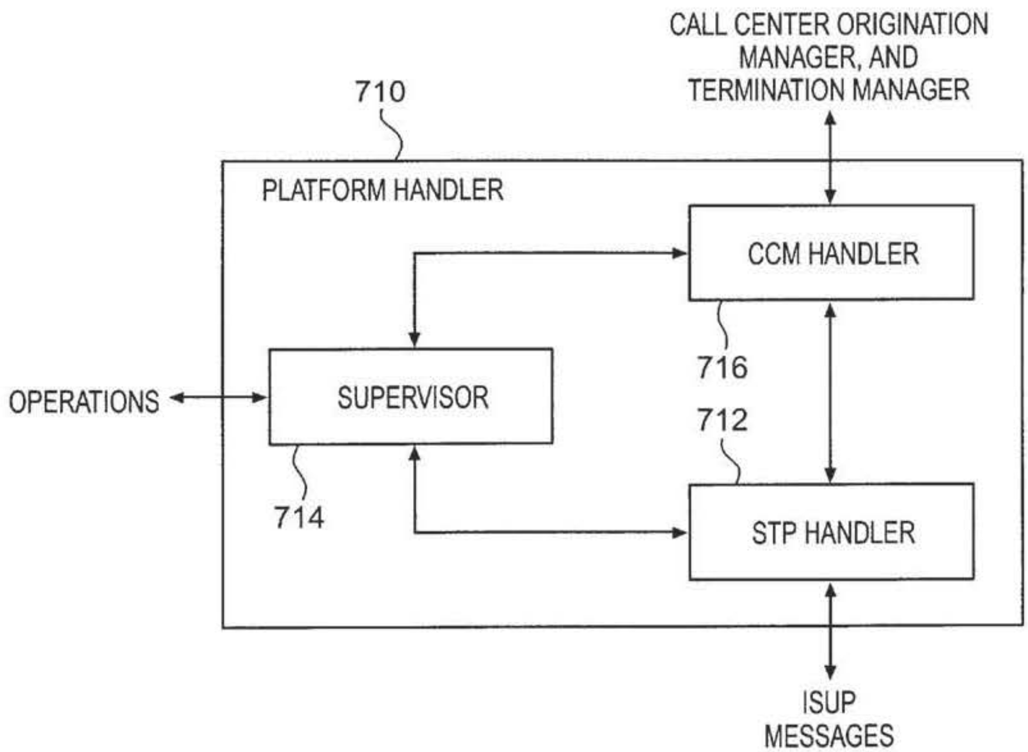
CALL CENTER ORIGINATION MANAGER, AND TERMINATION MANAGER
710
PLATFORM HANDLER
CCM HANDLER
716
OPERATIONS
SUPERVISOR
712
714
STP HANDLER
ISUP MESSAGES

FIG. 7

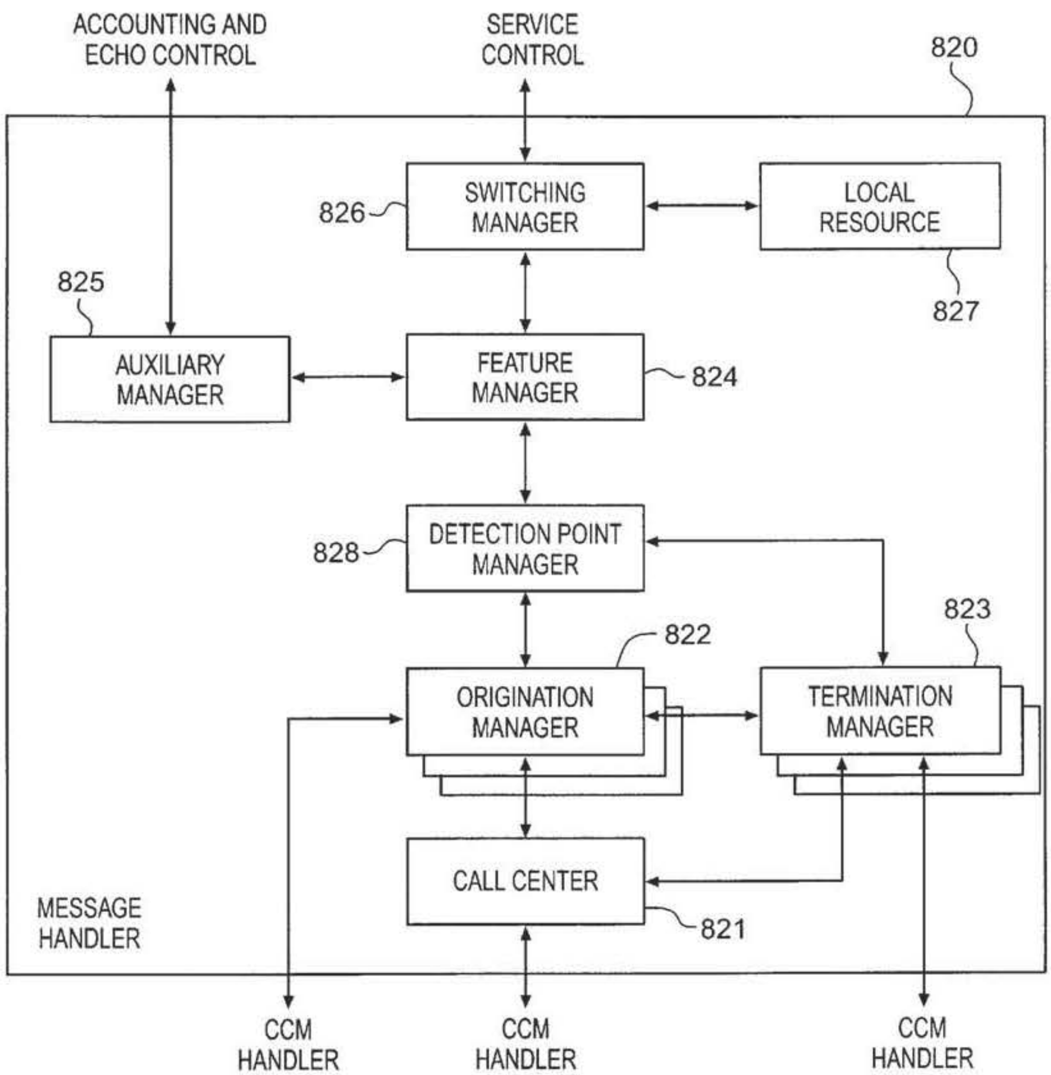
ACCOUNTING AND ECHO CONTROL
SERVICE CONTROL
820
SWITCHING MANAGER
826
LOCAL RESOURCE
827
825
AUXILIARY MANAGER
FEATURE MANAGER
824
DETECTION POINT MANAGER
828
822
823
ORIGINATION MANAGER
TERMINATION MANAGER
CALL CENTER
821
MESSAGE HANDLER
CCM HANDLER
CCM HANDLER
CCM HANDLER

FIG. 8

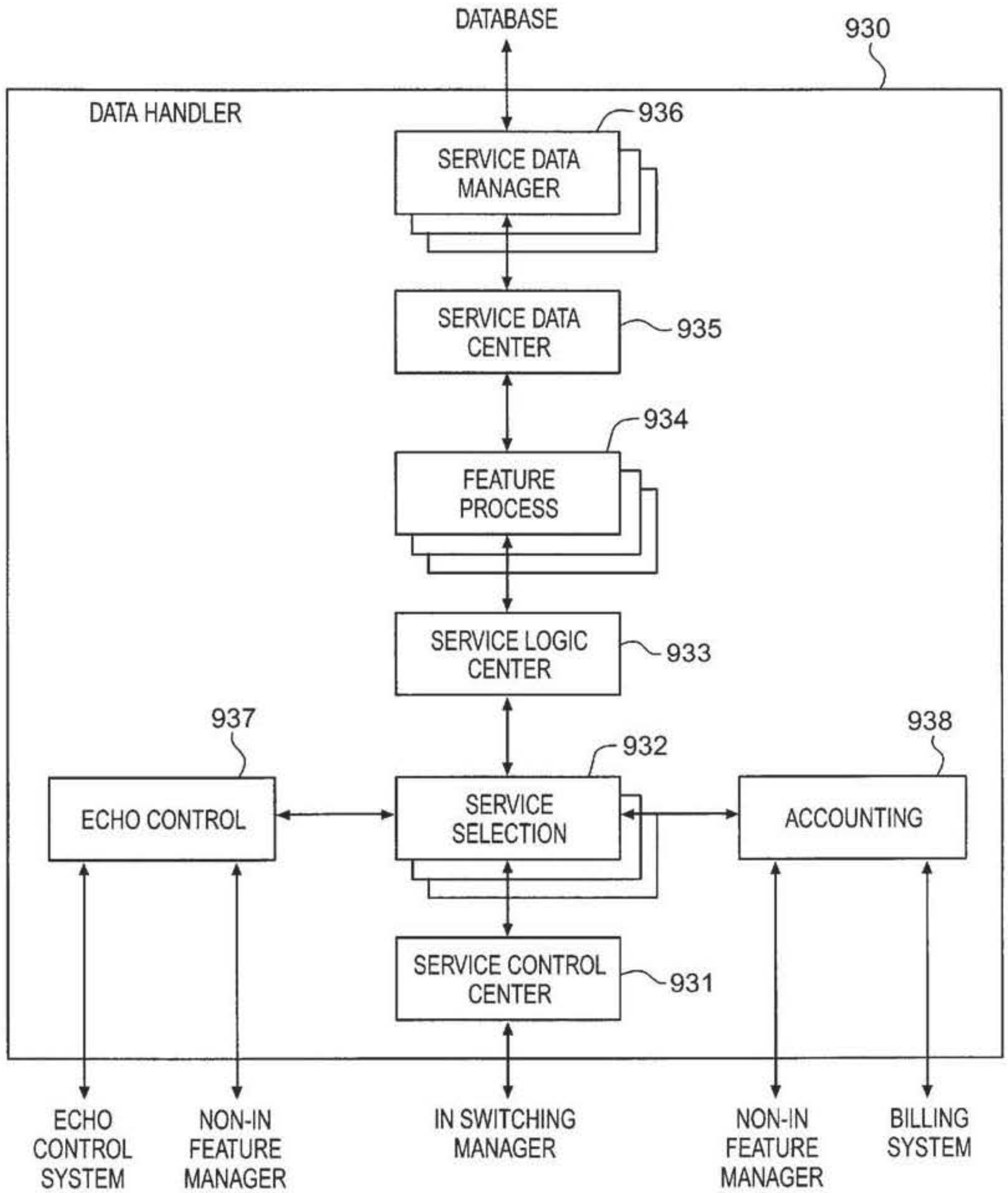
DATABASE
930
DATA HANDLER
936
SERVICE DATA MANAGER
SERVICE DATA CENTER
935
934
FEATURE PROCESS
SERVICE LOGIC CENTER
933
937
938
932
ECHO CONTROL
SERVICE SELECTION
ACCOUNTING
SERVICE CONTROL CENTER
931
ECHO CONTROL SYSTEM
NON-IN FEATURE MANAGER
IN SWITCHING MANAGER
NON-IN FEATURE MANAGER
BILLING SYSTEM

FIG. 9

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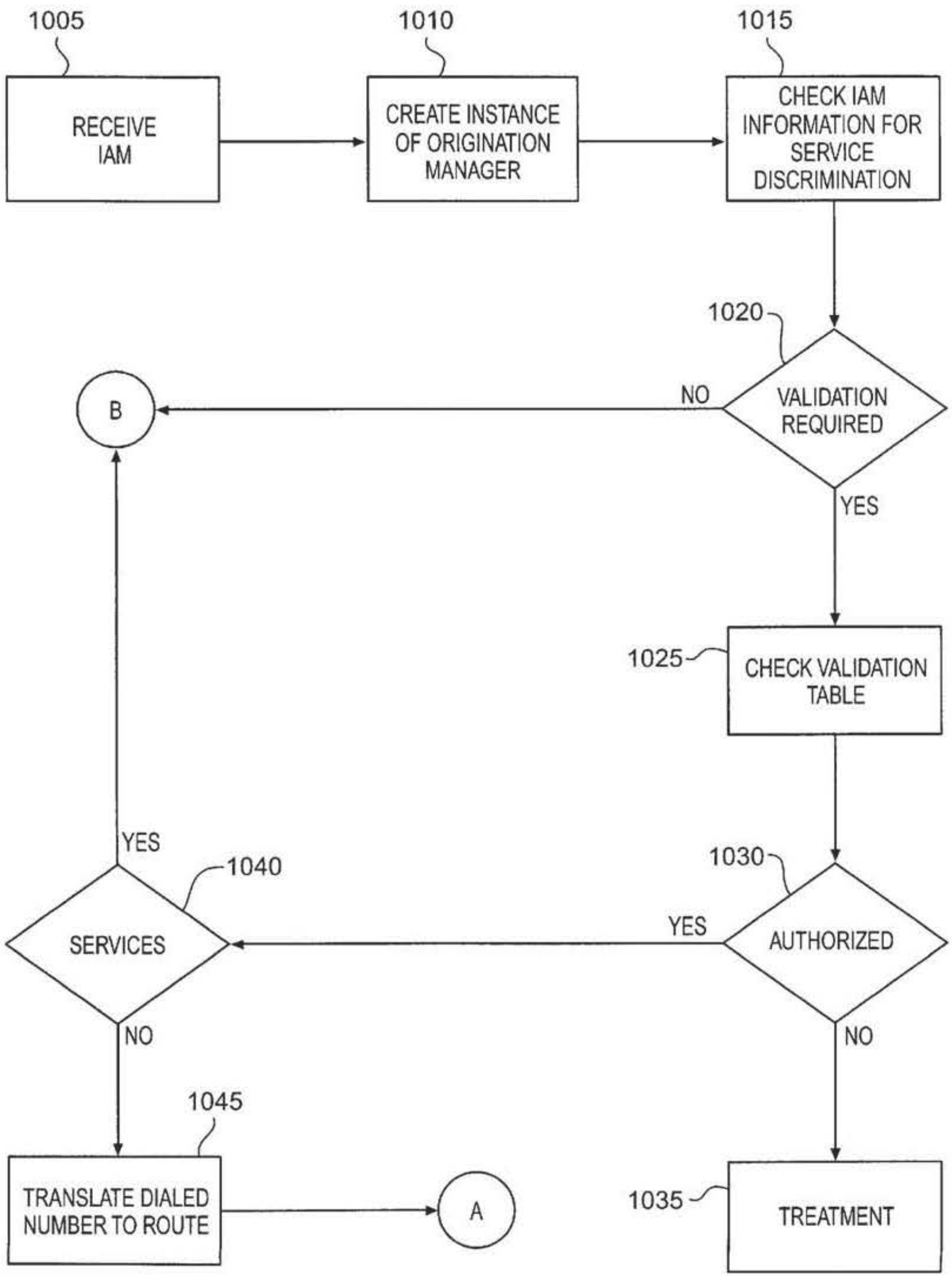

FIG. 10

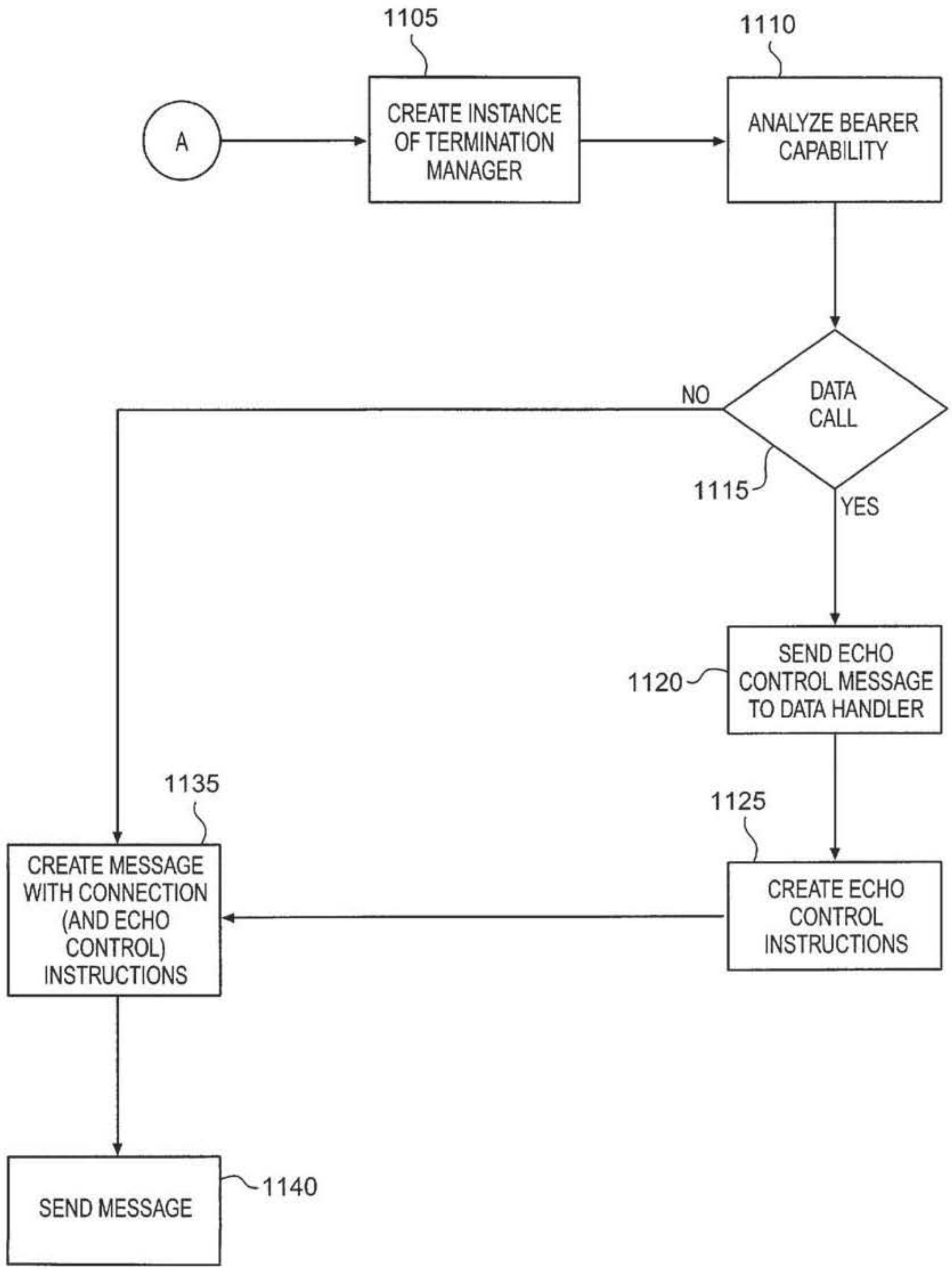
1105
1110
A
CREATE INSTANCE OF TERMINATION MANAGER
ANALYZE BEARER CAPABILITY
NO
DATA CALL
1115
YES
SEND ECHO CONTROL MESSAGE TO DATA HANDLER
1120
1135
1125
CREATE MESSAGE WITH CONNECTION (AND ECHO CONTROL) INSTRUCTIONS
CREATE ECHO CONTROL INSTRUCTIONS
SEND MESSAGE
1140

FIG. 11

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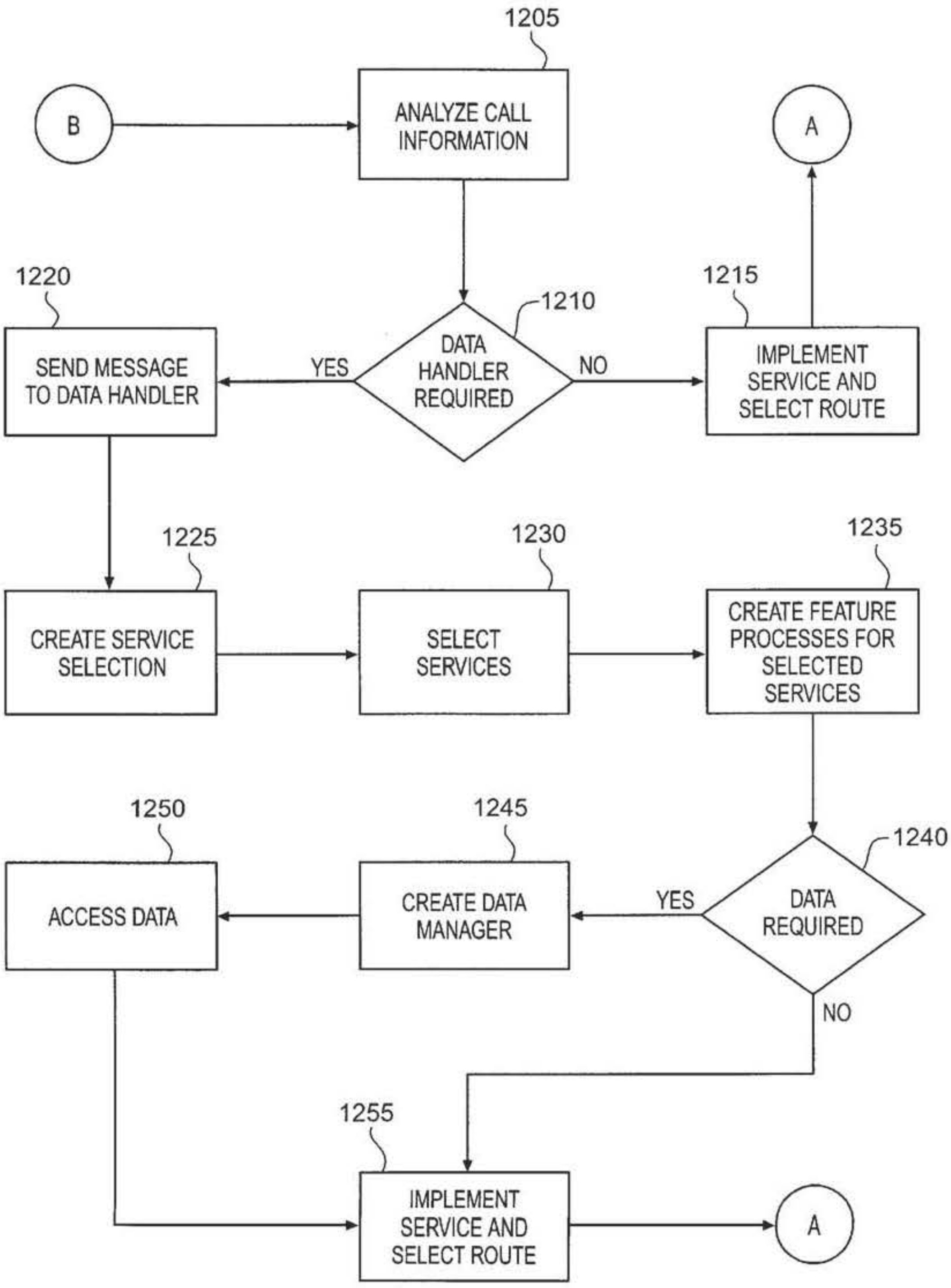

FIG. 12

BROADBAND TELECOMMUNICATIONS SYSTEM

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a continuation of U.S. patent application Ser. No. 09/353,401, entitled "BROADBAND TELECOMMUNICATIONS SYSTEM", filed Jul. 15, 1999, which is incorporated by reference into this application and which is a continuation of U.S. patent application Ser. No. 08/525,897, filed on Sep. 8, 1995, which is incorporated by reference into this application, and which is a continuation-in-part of U.S. Pat. No. 08/568,551, filed Dec. 7, 1995, now U.S. Pat. entitled "METHOD, SYSTEM, AND APPARATUS FOR TELECOMMUNICATIONS CONTROL", which is incorporated by reference into this application, and which is a continuation of U.S. patent application Ser. No. 08/238,605, filed May 5, 1994, now abandoned, which is incorprated by reference into this application.

BACKGROUND

At present, Asynchronous Transfer Mode (ATM) technology is being developed to provide broadband switching capability. Some ATM systems have used ATM cross-connects to provide virtual connections. Cross-connect devices do not have the capacity to process signaling. Signaling refers to messages that are used by telecommunications networks to set-up and tear down calls. Thus, ATM cross-connects cannot make connections on a call by call basis. As a result, connections through cross-connect systems must be pre-provisioned. They provide a relatively rigid switching fabric. Due to this limitation, ATM cross-connect systems have been primarily used to provide dedicated connections, such as permanent virtual circuits (PVCs) and permanent virtual paths (PVPs). But, they do not to provide ATM switching on a call by call basis as required to provide switched virtual circuits (SVCs) or switched virtual paths (SVPs). Those skilled in the art are well aware of the efficiencies created by using SVPs and SVCs as opposed to PVCs and PVPs. SVCs and SVPs utilize bandwidth more efficiently.

ATM switches have also been used to provide PVCs and PVPs. Since PVCs and PVPs are not established on a call-by-call basis, the ATM switch does need to use its call processing or signaling capacity. ATM switches require both signaling capability and call processing capability to provide SVCs and SVPs. In order to achieve virtual connection switching on a call by call basis, ATM switches are being developed that can process calls in response to signaling to provide virtual connections for each call. These systems cause problems because they must be very sophisticated to support current networks. These ATM switches must process high volumes of calls and transition legacy services from existing networks. An example would be an ATM switch that can handle large numbers of POTS, **800**, and VPN calls. This generation of sophisticated ATM switches is not yet mature and should be expensive when they are first deployed.

Currently, ATM multiplexers are being developed that can interwork traffic into ATM cells and multiplex the cells for transport over an ATM network. One example of an application of these muxes is provided by T**1** transport over an ATM connection. Traffic that leaves the switch in T**1** format is muxed into ATM cells for transport over a high speed connection. Before the cells reach another switch, they are converted back into the T**1** format. Thus, the ATM mux is

used for high speed transport. The ATM mux is not used to select virtual connections on a call-by-call basis. Unfortunately, there is not a telecommunications system that can provide ATM switching on a call by call basis without relying on the call processing and signaling capability of an ATM switch.

SUMMARY

The invention includes a method of operating a telecommunications system to provide a call with a virtual connection. The method is for use when a user places the call by sending signaling for the call to the telecommunications system and by transmitting user information to the telecommunications system over a particular connection. The system comprises an ATM interworking multiplexer and a signaling processor linked to the ATM interworking multiplexer. The method comprises receiving the signaling for the call into the signaling processor, processing the signaling to select the virtual connection, generating new signaling to identify the particular connection and the selected virtual connection, and then transmitting the new signaling to the ATM interworking multiplexer. The method also includes receiving the user information for the call from the particular connection into the ATM interworking multiplexer, converting the user information into ATM cells that identify the selected virtual connection in response to the new signaling, and transmitting the ATM cells over the selected virtual connection. The signaling for the call could be a call set-up message, such a Signaling System **#7** (SS**7**) initial address message (IAM). The method could also include applying digital signal processing (DSP) to the call in the multiplexer in accord with DSP requirements selected by the signaling processor. DSP requirements could include echo control or encryption.

The invention also includes a telecommunications system to provide a call with a virtual connection in response to signaling for the call. The system comprises a signaling processor to receive and process signaling to select the virtual connection for the call, and to generate and transmit new signaling that identifies the selected virtual connection. The system includes an ATM interworking multiplexer to receive user information from a connection, convert the user information into ATM cells that identify the selected virtual connection, and transmit the ATM cells over the selected virtual connection. The system could also include an ATM cross-connect system connected to the ATM interworking multiplexer and configured to provide a plurality of virtual connections to the ATM interworking multiplexer.

The invention also includes an ATM interworking multiplexer for providing calls with virtual connections in response to signaling for each of the calls. The multiplexer comprises an access interface to receive user information for each call from a particular connection. It also includes a control interface to receive signaling for each call that identifies the particular connection and a virtual connection for that call. It also includes an ATM adaption processor to convert user information from the particular connection for each call into ATM cells that identify the virtual connection for that call. The multiplexer also includes an ATM interface to transmit the ATM cells for each call over the virtual connection. The multiplexer could include a digital signal processor to apply digital signal processing to the user information for each call. The processing could include echo control and encryption.

In various embodiments, the invention accepts calls placed over DS**0** voice connections and provides virtual

connections for the calls. In this way, broadband virtual connections can be provided to narrowband traffic on a call-by-call basis without requiring the call processing and signaling capability of an ATM switch.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a block diagram of a version of the present invention.

FIG. **2** is a block diagram of a version of the present invention.

FIG. **3** is a block diagram of a version of the present invention.

FIG. **4** is a block diagram of a version of the present invention.

FIG. **5** is a block diagram of a version of the present invention.

FIG. **6** depicts a logic diagram of a version of the invention.

FIG. **7** depicts a logic diagram of a version of the invention.

FIG. **8** depicts a logic diagram of a version of the invention.

FIG. **9** depicts a logic diagram of a version of the invention.

FIG. **10** depicts a flow diagram of a version of the invention.

FIG. **11** depicts a flow diagram of a version of the invention.

FIG. **12** depicts a flow diagram of a version of the invention.

DETAILED DESCRIPTION

For purposes of clarity, the term "connection" will be used to refer to the transmission media used to carry user traffic. The term "link" will be used to refer to the transmission media used to carry signaling. On the Figures, connections are shown by a single line and signaling links are shown by double lines.

FIG. **1** depicts a version of the present invention. Shown is telecommunications system **100**, user **110**, and user **120**. Telecommunications system **100** includes ATM interworking multiplexer (mux) **130**, mux **140**, ATM cross-connect system **150**, and signaling processing system **160**. User **110** is connected to mux **130** by connection **180**. Mux **130** and mux **140** are connected through cross-connect system **150** by connection **181**. Mux **140** is connected to user **120** by connection **182**. Signaling processing system **160** is linked to user **110** by link **190**, to mux **130** by link **191**, to mux **140** by link **192**, and to user **120** by link **193**.

Those skilled in the art are aware that large networks have many more components than are shown. For example, there would typically be a multitude of virtual connections through ATM cross-connect system **150**. The number of these components has been restricted for clarity. The invention is fully applicable to a large network.

User **110** and user **120** could be any entity that supplies telecommunications traffic to network **100**. Some examples would be a local exchange carrier (LEC) switch or customer premises equipment (CPE). Typically, the user traffic would be provided to system **100** in DS3, DS1, or OC-3 format that have embedded DS**0** and VT 1.5 circuits. Connections **180** and **182** represent any connection that might be used by user **120** to access system **100** and would also include formats such as E1, E3, and DS2. As such, these connections are periodically referred to as access connections. Connections **180** and **182** would typically be DS**0** connections embedded within a DS**3** connection, however, the invention fully contemplates other connection being used with a few examples being a fractional DS**1**, a clear DS**3**, or even SONET OC-**3**. Links **190** and **193** are any links capable of transferring signaling messages with an example being Signaling System #7 (SS7) links. ATM cross-connect system **150** is any system that provides a plurality of virtual connections. Such a system could be comprised of individual ATM cross-connect devices interconnected by ATM connections using DS**3** or SONET for transport. An example of an ATM cross-connect is the NEC Model **10**. Connection **181** could be any virtual connection. Typically, the virtual connection would use DS3 or SONET for transport. ATM cross-connect system **150** would be pre-provisioned to provide a plurality of virtual connections through the cross-connect system, and virtual connection **181** represents one of these connections. As virtual connections are logical paths, many physical paths can be used based on the pre-provisioning of ATM cross-connect system **150**. Links **191** and **192** could be any links capable of transporting data messages. Examples of such links could be SS7 or UDP/IP. The components described in this paragraph are known in the art.

Signaling processing system **160** is any processing platform that can receive and process signaling to select virtual connections, and then generate and transmit signaling to identify the selections. Various forms of signaling are contemplated by the invention, including SS7, C7, and user to network interface (UNI) signaling. A preferred embodiment of the signaling processor is discussed in detail toward the end of the disclosure.

Mux **130** could be any muxing system operable to place user information arriving over connection **180** on the virtual connection selected by signaling processing system **160**. Typically, this involves receiving signaling messages from signaling processing system **160** that identify assignments of virtual connections to an access connection on a call by call basis. The mux would convert user traffic from access connection **180** into ATM cells that identify the selected virtual connection. Mux **140** is similar to mux **130**. A preferred embodiment of these muxes are also discussed in detail below.

The system would operate as follows for a call from user **110** to user **120**. User **110** would send a signaling message over link **190** to system **100** initiating the call. Signaling processing system **160** would process the message. Such processing could include validation, screening, translating, route selection, echo control, network management, signaling, and billing. In particular, a virtual connection through ATM cross-connect system **150** from mux **130** to mux **140** would be selected, and a connection from mux **140** to user **120** would also be selected. Although many possible connections would be available, only the selected connections are shown—connection **181** and connection **182**. Generally, the selection is based on the dialed number, but call processing can entail many other factors with a few examples being network loads and user routing instructions. Signaling processing system **160** would then send signaling reflecting the selections to mux **130** and mux **140**.

User **110** would also seize a connection to system **100**. The connection is represented by connection **180** to mux **130**. Although, only one connection is shown for purposes of clarity, numerous connections would typically be available for seizure. The seized connection would be identified in the signaling from user **110** to system **100**. Signaling processing

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system **160** would include the identity of this connection in its signal to mux **130**.

If required, user **120** would receive signaling to facilitate completion of the call. The signaling from signaling processing system **160** would indicate that system **100** was connecting to user **120** over connection **182**. Typically, user **120** would accept and acknowledge the connection in a signaling message back to system **100**.

Mux **130** would receive signaling from signaling processing system **160** identifying connection **180** as the access connection and connection **181** as the selected virtual connection through ATM cross-connect system **150**. Mux **130** would convert the user information from connection **180** into ATM cells. Mux **130** would designate connection **181** in the cell headers. Connection **181** would have been previously provisioned through ATM cross-connect system **150** from mux **130** to mux **140**.

Mux **140** would receive signaling from signaling processing system **160** identifying connection **181** as the selected virtual connection and connection **182** as the selected access connection to user **120**. Mux **140** would convert cells arriving on connection **181** to user information suitable for connection **182** to user **120**. Although the above example employs two muxes, a single mux could be employed for calls that enter and exit system **100** through the same mux. In this case, the ATM system would simply provide a virtual connection back to the same mux.

From the above discussion, it can be seen that multiple virtual connections can be pre-provisioned through an ATM cross-connect system to interconnect ATM interworking multiplexers. When a user places a call, one of the virtual connections is selected for the call by the signal processing system and identified to the appropriate muxes. The muxes convert the user information into cells that identify the selected connection. As such, user information can be switched through an ATM fabric on a call by call basis. The system does not require the call processing or signaling capabilities of an ATM switch (although an ATM switch could be used to provide the virtual connections without using its call processing and signaling functions). The system can also implement enhanced services such as **N00** and virtual private network (VPN).

FIG. **2** depicts another embodiment of the invention. In this embodiment, the user information from the access connection is capable of being muxed to the DS**0** level, but this is not required in other embodiments. Additionally, SS**7** signaling is used in this embodiment, but other signaling protocols, such as C7 or UNI signaling, are also applicable to the invention.

Shown are DS**0** interface **210**, ATM adaption layer (AAL) **220**, ATM interface **230**, DS**0**—virtual connection assignment **240**, call/connection manager (CCM) **250** and signal transfer point (STP) **260**. Also shown are connections **280–283** and links **290–292**.

Connection **280** could by any connection or group of connections that contain information that can be converted to DS**0** format. Examples of these connections are OC-**3**, VT**1.5**, DS**3**, and DS**1**. DS**0** interface **210** is operable to convert user information in these formats into the DS**0** format. AAL **220** comprises both a convergence sublayer and a segmentation and reassembly (SAR) layer. AAL **220** is operational to accept the user information in DS**0** format from DS**0** interface **210** and convert the information into ATM cells. AALs are known in the art and information about AALs is provided by International Telecommunications Union (ITU) document I.**363.1**. An AAL for voice is also described in patent application Ser. No. 08/395,745, filed on Feb. 28, 1995, entitled "Cell Processing for Voice Transmission", and hereby incorporated by reference into this application. ATM interface **230** is operational to accept ATM cells and transmit them over connection **283**. Connection **283** is a standard DS3 or SONET connection transporting ATM cells. Connection **281** is operational for the DS**0** format and connection **282** is operational to transfer ATM cells.

It can be seen that a communications path through connections **280–283** could be established to carry user information. Although the communications path has been described from connection **280** to connection **283**, the invention contemplates components that are also operational to perform reciprocal processing in the reverse direction. If the communications path is bi-directional, user information in ATM cells arriving on connection **283** would be processed for output on connection **280** in the appropriate format. Those skilled in the art will appreciate that separate connections could also be set up in each direction, or that only a connection in one direction may be required. These components and their operation are known in the art.

Signaling links **290** and **291** are SS**7** links. Link **292** is a data link with an example being an ethernet connection transporting UDP/IP. STP **260** is device that routes signaling messages. STPs are well known in the art. CCM **250** would be identified by its own signaling point code. STP **260** would route signaling messages addressed to this point code to CCM **250**. In some embodiments, STP **260** may also convert other point codes to the point code for CCM **250** so these signaling messages are also routed to CCM **250**. Although point code conversion is not essential, it facilitates the transition of a network to the system of the invention. The conversion could be implemented through a conversion table located between level **2** and level **3** of the message transfer part (MTP) function of STP **260**. The conversion table would convert the destination point code of the message to that of CCM **250**, so that the route function of MTP **3** would forward the message to CCM **250**. Point code conversion could be based on many factors with a few examples being the destination point code, the origination point code, the signaling link, the circuit identification code, the message type, and various combinations of these and other factors. For example, SS**7** Integrated Services User Part (ISLUP) messages with particular OPC/DPC combinations could have the DPC converted to the point code of CCM **250**. These signaling messages would then be routed to CCM **250** by STP **260**. One version of a suitable STP is disclosed in U.S. patent application entitled "Telecommunications Apparatus, System, and Method with Enhanced Signal Transfer Point", filed simultaneously with this application, assigned to the same entity, and hereby incorporated by reference into this application.

CCM **250** is a signaling processor that operates as discussed above. A preferred embodiment of CCM **250** is provided later. In this embodiment CCM **250** would be operable to receive and process SS7 signaling to select connections, and to generate and transmit signaling identifying the selections.

Assignment **240** is a control interface that accepts messages from CCM **250**. In particular, assignment **240** identifies DSO/virtual connection assignments in the messages from link **292**. These assignments are provided to AAL **220** for implementation. As such, AAL **220** obtains the virtual path identifier (VPI) and virtual channel identifier (VCI) for each call from assignment **240**. AAL **220** also obtains the identity of the DS0 for each call (or the DSOs for an N×64

call). AAL **220** then converts user information between the identified DS**0** and the identified ATM virtual connection. Acknowledgments that the assignments have been implemented may be sent back to CCM **250** if desired.

In operation, calls are processed as follows. Signaling messages for calls arrive on link **290** and are routed by STP **260** to CCM **250**. Access connections are typically seized contemporaneously with the signaling. All of these connections are represented by connection **280**. DS**0** interface **210** would convert the traffic on connection **280** into the DS**0** format and provide the DSOs to AAL **220** over connection **281**.

The signaling received by CCM **250** would identify the access connections for the calls (i.e. the particular DSOs on connection **280**), and contain call information, such as a dialed number. CCM **250** would process the signaling and select connections for the call. Since multiple virtual connections are pre-provisioned from ATM interface **230** to the other destinations in the network, CCM **250** can select a virtual connection to the destination. The selection process can be accomplished through table look-ups. For example, a table could be used to translate a portion of the dialed number into a VPI. The VCI would be selected based on the available VCIs in the selected VPI. The VPI/VCI combination would correspond to a unique virtual connection pre-provisioned from ATM interface **230** to the appropriate network destination. The selections represent the DS**0**—virtual connection assignments that are provided to assignment **240** over link **292**.

Assignment **240** accepts the DS**0**—virtual connection assignments and provides them to AAL **220**. When AAL **220** receives a particular assignment, it converts user information from the designated DS**0** into cells that identify the designated VPI/VCI. The cells are provided to ATM interface **230** over connection **282**. ATM interface **230** accepts the cells and places them within the transport format for connection **283**. The cells are then transported over the selected virtual connection to the appropriate destination.

Calls also exit the network through connection **280**. In this case, CCMs at the origination points select the virtual connections to ATM interface **230**. The originating CCMs also send signaling messages to CCM **250**. The signaling messages identify the destinations for the calls and the selected virtual connections. CCM **250** will have a list of available access connections to the identified destinations. CCM **250** will select the access connections to the destination from the list. For example, the connection selected by CCM **250** could be a DS**0** embedded within a DS3 connected to a LEC. The virtual connections on connection **283** and selected access connections on connection **280** are provided to assignment **240** over link **292**. Assignment **240** provides these assignments to AAL **220**.

ATM interface **230** will demux the cells arriving from connection **283** and provide them to AAL **220**. AAL **220** converts the user information in the cells into the DS**0** format. AAL **220** make the conversion so that cells from a particular virtual connection are provided to the assigned DS**0** on connection **281**. DS**0** interface will convert the DSOs from connection **281** into the appropriate format, such as DS3, for connection **280**. Those skilled in the art are aware of the techniques for muxing and transporting DS**0** signals.

From the above discussion, it can be seen that user information for calls can flow from connection **280** to connection **283**, and in the reverse direction from connection **283** to connection **280**. DS**0** interface **210** and ATM interface **230** provide user information in their respective formats to AAL **220**. AAL **220** converts the user information between DS**0** and ATM formats based on the assignments from assignment **240**. CCM **250** can select the DSO—virtual connection assignments that drive the process.

The ATM Interworking Multiplexer

FIG. **3** shows one embodiment of the mux that is suitable for the present invention, but muxes that support the requirements of the invention are also applicable. Shown are control interface **300**, OC-**3** interface **305**, DS3 interface **310**, DS1 interface **315**, DS**0** interface **320**, digital signal processing(DSP) **325**, AAL **330**, and OC-**12** interface **335**.

OC-**3** interface **305** accepts the OC-**3** format and makes the conversion to DS3. DS**3** interface **310** accepts the DS3 format and makes the conversion to DS**1**. DS3 interface **310** can accept DS3s from OC-**3** interface **305** or from an external connection. DS1 interface **315** accepts the DS**1** format and makes the conversion to DSO. DS1 interface **315** can accept DSls from DS3 interface **310** or from an external connection. DS**0** interface **320** accepts the DS**0** format and provides an interface to digital signal processing (DSP) **325**.

DS**0** interface **320** is coupled to DSP **325**. DSP **325** is capable of manipulating the user information to improve transmission quality. DSP processing primarily entails echo cancellation, but could include other features as well. As is known, echo cancellation can be required for voice calls. DSP **325** passes the DSOs through echo cancellers. These echo cancellers must be disabled for calls that do not require echo control. Data calls do not require echo cancellation, and the CCM has the ability to recognize data calls that require an echo canceller to be disabled. The CCM will send a control message through control interface **300** to DSP **325** indicating the particular echo canceller that is to be disabled. The CCM selects the echo canceller based on the CIC in the signaling it receives from the user. After the data call, the CCM sends a message that causes the particular echo canceller to be enabled again for subsequent voice calls. The above technique of applying echo control is preferred, but other means of implementing echo control instructions from the CCM are also applicable.

In addition to echo control, the CCM and the mux can work to provide other digital signal processing features on a call by call basis. Compression algorithms can be applied, either universally, or on a per call basis. The decibel level could be adjusted for calls form a particular origin or to a particular destination, i.e. where a hearing impaired person may reside. Encryption could be applied on a call-by-call basis based on various criteria like the origination number or the destination number. Various DSP features could be associated with various call parameters and implemented by the CCM through DSP **325**.

DSP **325** is connected to AAL **330**. AAL **330** operates as described above for an AAL. DSO—virtual connection assignments from control interface **300** are implemented by AAL **330** when converting between the DS**0** and ATM formats.

Calls with a bit rate greater than 64 kbit/sec. are known as Nx**64** calls. If desired, AAL **330** can be capable of accepting control messages through control interface **300** from the CCM for N×64 calls. The CCM would instruct AAL **330** to group the DSOs for the call.

The ATM Cross-connect System

FIG. **4** depicts virtual connections provided by the ATM cross connect system in a version of the invention, although

numerous other techniques for providing virtual connections will be appreciated by one skilled in the art, and the invention contemplates any such system. Shown are virtual connections **410**, **412**, **414**, **416**, **418**, and **420**. These virtual connections are shown interconnecting muxes A, B, and C through cross-connects Y and Z. Virtual connections are provisioned in between each mux. Each mux would have a virtual path to the cross-connect system that is designated for each possible destination mux. Virtual path AB contains virtual connection **412** from mux A to mux B. For calls that originate and terminate at the same mux, virtual connections **410**, **416**, and **420** are provisioned for that purpose. Virtual connections **414** and **418** connect muxes A/C and B/C respectively. Alternate routes for different virtual connections can be provisioned between the same two muxes.

Within each virtual path are thousands of virtual channels (not shown). Virtual connections are provisioned by cross-connecting VPI/VCI combinations at cross-connects Y and Z. If a call enters mux A and needs to terminate at mux B, the CCM will select virtual path AB. The selection could be based on a translation of the dialed number. Within virtual path AB, the CCM would select the particular virtual channel. This selection could be based on available VCIs within the VPI. In this way, pre-provisioned virtual connections can be selected on a call by call basis.

Typically, calls will require a bidirectional voice connection. For this purpose, a virtual connection must transport user information in both directions. The virtual connections can be provisioned so that the mux at the terminating end may use the same VPI/VCI for cells transported in the opposite direction. The terminating CCM could also translate the originating VPI/VCI into another VPI/VCI provisioned in the opposite direction and provide this VPI/VCI to the terminating mux.

Additionally, the number of active virtual connections in between cross-connects can be tracked. Virtual path YZ connects cross-connects Y and Z. The capacity of virtual path YZ would be sized based on network requirements, but should it become overloaded, the CCMs can be programmed to select an alternate virtual path.

Operation Within a Network

FIG. **5** depicts an embodiment of the invention with respect to a specific telecommunications network scenario, although the invention is not limited to this specific scenario. FIG. **5** shows telecommunications system **500**. Shown are user **510**, user **512**, user **514**, user **516**, STP **518**, STP **520**, STP **522**, STP **524**, mux **526**, mux **528**, mux **530**, mux **532**, call/connection manager (CCM) **534**, CCM **536**, CCM **538**, CCM **540**, ATM cross-connect **542**, ATM cross-connect **544**, and ATM cross-connect **546**. For clarity, the connections and signaling links are not numbered. All of these components are described, and the CCMs are also discussed below.

In operation, user **510** may forward an **800** call to system **500**. User **510** could be connected to mux **526** with a DS3 connection. The **800** call would occupy a DS**0** embedded in the DS3 connected to mux **526**. User **510** would send an SS7 Initial Address Message (IAM) through STP **518** to system **500**. STP **520** would be configured to route the IAM to CCM **534**. An IAM contains information such as the dialed number, the caller's number, and the circuit identification code (CIC). The CIC identifies the DS**0** used by user **510** for the call.

CCM **534** would process the IAM and identify that the call was an **800** call. Either through its own database or by accessing a service control point (SCP) (not shown), the CCM would translate the dialed number based on the **800** subscriber's routing plan. For example, **800** calls from user **510** may be routed to user **512** during business hours, to user **514** at night, and to user **516** on weekends. If the call is placed from user **512** on a weekend, the call would be routed to user **516**. As such, CCM **534** would select a pre-provisioned virtual connection from mux **526** through ATM cross-connect **542** and ATM cross-connect **544** to mux **530**. CCM **534** would send an IAM message to CCM **538** through STP **520** and STP **522**. The IAM would indicate that a call was being routed to user **516** and would identify the selected virtual connection being used to reach mux **530**.

Typically, mux **530** would be connected to user **516** with a DS3 connection. CCM **538** would select a DS**0** embedded in the DS3 and would send an LAM to user **516** through STP **522** and STP **524**. The CIC of the LAM would indicate that a call was being routed to user **516** over the selected DSO. User **516** would process the IAM and complete the call. When the call is answered, user **516** would transmit an answer message (ANM) through STP **524** back to system **500**.

CCM **534** would also send a UDP/IP message to mux **526** instructing it to assemble the user information in the DS**0** from user **510** into ATM cells with a cell header identifying the selected virtual connection. CCM **538** would send a UDP/IP message to mux **530** instructing it to dis-assemble ATM cells from the selected virtual connection and output the user information to the selected DS**0** to user **516**. ATM cross-connect **542** would route ATM cells from mux **526** to ATM cross-connect **544** based on the cell header. Likewise, ATM cross-connect **544** would route these cells to mux **530** based on the cell header. As such, user information for the call would flow from user **510** to user **516** over the DS**0** from user **510**, the virtual connection selected by CCM **534**, and the DS**0** to user **516** selected by CCM **538**. The muxes would implement the selections of the CCMs.

The call would require that a voice channel be available in both directions. As such, the DSOs and virtual connection would be bi-directional. Cut-through on the receive channel (from the user **516** to the user **510**) would occur after the address complete message (ACM) had been received by system **500**. Cut-through on the transmit channel (from the user **510** to the user **516**) would occur after the answer message (ANM) had been received by system **500**. This could be accomplished by not allowing mux **530** to release any cells for the call until the ANM has been received by system **500**.

If user **510** were to place the call at night, CCM **534** would determine that user **514** was the destination. Accordingly a pre-provisioned virtual connection from mux **526** through ATM cross-connect **542** and ATM cross-connect **546** to mux **528** would be selected for the call. CCM **536** would select the DS**0** to user **514**.

If user **510** were to place the call during the day, CCM **534** would determine that user **512** was the destination. Accordingly a pre-provisioned virtual connection from mux **526** through ATM cross-connect **542** and back to mux **526** would be selected for the call. CCM **534** would also select the DS**0** to user **512**.

The Call/Connection Manager (CCM)

FIGS. **6**–**12** refer to a preferred embodiment of the signaling processor, also known as the CCM, but any processor which supports the requirements stated for the invention would suffice. FIG. **6** depicts a signaling processor suitable for the invention. Signaling processor **610** would

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typically be separate from the mux, but those skilled in the art appreciate that they could be housed together. Also, signaling processor may support a single mux or support multiple muxes.

Signaling processor **610** includes Message Transfer Part (MTP) level 1 **612**, MTP level 2 **615**, and MTP level 3 **620**. MTP level 1 **612** defines the physical and electrical requirements for a signaling link. MTP level 2 **615** sits on top of level 1 and maintains reliable transport over a signaling link by monitoring status and performing error checks. Together, MTP levels 1–2 provide reliable transport over an individual link. A device would need MTP level 1–2 functionality for each link it uses. MTP level 3 **620** sits on top of level 2 and provides a routing and management function for the signaling system at large. MTP level 3 **620** directs messages to the proper signaling link (actually to the MTP level 2 for that link). MTP level 3 **620** directs messages to applications using the MTP levels for access the signaling system. MTP level 3 **620** also has a management function which monitors the status of the signaling system and can take appropriate measures to restore service through the system. MTP levels 1–3 correspond to layers 1–3 of the open systems interconnection basic reference model (OSIBRF). Both the MTP 1–3 and the OSIBRF are well known in the art

Also shown for signaling processor **610** are ethernet interface **635**, platform handler **640**, message handler **645**, and data handler **650**. Ethernet interface **635** is a standard ethernet bus supporting TCP/IP which transfers signaling messages from MTP level 3 to platform handler **640**. Also, if UDP/IP is used to communicate with the muxes, ethernet interface **335** would accept the links to the muxes. Those skilled in the art will recognize other interfaces and protocols which could support these functions in accord with the invention.

In accord with this invention, the logic of the signaling interface (indicated by reference numerals **612**, **615**, **620**, and **635**) would be operational to route select ISUP messages to platform handler **640**. Technique for doing this have been discussed above. Preferably, an SS7 interface to platform handler **640** could be constructed using commercially available SS7 software interface tools. An example of such tools would be SS7 interface software provided by Trillium, Inc.

Platform handler **640** is a system which accepts ISUP and B-ISUP messages from ethernet interface **635** and routes them to message handler **645**. Preferably, platform handler **640** is configured to route messages to a particular message handler processor based on the signaling link selection (SLS) code in the message. Message handler **645** is a system which exchanges signaling with platform handler **640** and controls the connection and switching requirements for the calls. It can select and implement services and initiate echo control. It also converts signaling between ISUP and B-ISUP. Data handler **650** is a set of logic coupled to message handler **645** which processes service requests and provides data to message handler **645**. Data handler **650** also controls echo cancellers and generates billing records for the call.

In the discussions that follow, the term ISUP will include B-ISUP as well. In operation, ISUP messages that meet the proper criteria are routed by MTP and/or ATM interface **615**, MTP level 3 **620**, and ethernet interface **635** to platform handler **640**. Platform handler **640** would route the ISUP messages to message handler **645**. Message handler **645** would process the ISUP information. This might include validation, screening, and determining if additional data is needed for call processing. If so, data handler **650** would be invoked and would provide message handler **645** with the relevant data so message handler **645** could complete call processing. Message handler **645** would generate the appropriate ISUP message to implement the call and pass the signals to platform handler **640** for subsequent transmission to the designated network elements.

The distribution of functional entities among message handler **645** and data handler **650** are shown. These functional entities are well known in the art. Message handler **645** includes at least the call control function (CCF) and the service switching function (SSF). The CCF establishes and releases call connections, and the SSF recognizes triggers during call processing by the CCF and provides an interface between the CCF and the service control function (SCF). The SCF identifies services and obtains data for the service. In some embodiments, message handler **645** can include the SCF and the service data function (SDF). The SDF provides service data in real time to the SCF. Taken together, message handler **645** is able to at least control connections and recognize triggers. In some embodiments, message handler **645** can also identify services, obtain data for the services, and generate the signaling required to implement the services. Message handler **645** can provide signaling interworking (i.e. ISUP to B-ISUP), connection control, service selection and service implementation in a logically integrated package that interfaces with the network through conventional means.

Data handler **650** includes at least the SCF and the SDF. In some embodiments, message handler **645** and data handler **650** both include the SCF and the SDF and services are partitioned among the functional entities. Two other functions are shown in data handler that are not standardized functional entities. Accounting generates a billing record and echo handles the echo cancellers. Typically, an echo canceller is disabled for a data call and enabled after the data call for use on subsequent voice calls, however, other techniques are applicable.

In operation, the CCF would perform basic call processing until the SSF recognized a trigger and invoked the SCF. The SCF would identify the service associated with the trigger. The SCF would access data from the SDF in order to implement the service. The SCF would process the data from the SDF and provide the data to the CCF through the SSF. The CCF would then set-up the connections through conventional signaling to service switching points (SSPs). The SSPs are connected to the communications path and make the connections. Typically, an SSP is a switch. Also, echo cancellers may be controlled for the call, and a billing record could be generated for the call.

Those skilled in the art are aware of various hardware components which can support the requirements of the invention. For example, the platform handler, message handler, and data handler could each reside on a separate SPARC station **20**.

The Platform Handler

FIG. **7** shows a possible version of the platform handler. Platform handler **710** is shown. Platform handler **710** includes STP handler **712**, supervisor **714**, and CCM handler **716**. Platform handler **710** transmits and receives ISUP messages to/from the signaling interface (reference numerals **312**, **315**, **320**, and **335**). STP handler **712** would provide the ethernet—TCP/IP interface. STP handler **712** has a process to buffer and dis-assemble the incoming packets to the CCM, and buffer and assemble outgoing packets. STP

handler **712** could also check the messages for basic flaws. Any technique for transfer of signaling messages to platform handler **710** is contemplated by the invention.

Supervisor **714** is responsible for managing and monitoring CCM activities. Among these are CCM start-up and shut-down, log-in and log-off of various CCM modules, handling administrative messages (i.e. error, warning, status, etc.) from the CCM modules, and handling messages from network operations such as queries, configuration instructions, and data updates. The connection to network operations is the man machine interface which allows the CCM to be controlled and monitored by either a remote or a local operator. Supervisor **714** has a process which retrieves configuration data from internal tables to initialize and configure the CCM. The CCM modules also have internal tables which are used in conjunction with this procedure. Supervisor **714** also communicates internally with STP handler **712** and CCM handler **716**.

CCM handler **716** exchanges ISUP information with STP handler **712**. CCM handler **716** also exchanges ISUP messages and CCM supervisory messages with the message handler. The connection between CCM handler **716** and the message handler could be an ethernet LAN transporting these messages encapsulated in TCP/IP packets, but other methods are known. CCM handler **716** would provide the ethernet—TCP/IP interface. CCM handler **716** has a process to buffer and dis-assemble the incoming packets from the message handler, and buffer and assemble outgoing packets to the message handler. CCM handler **716** could also check the messages for basic flaws.

Internally, platform handler **710** is equipped with bi-directional channels which exchange information among STP handler **712**, supervisor **714**, and CCM handler **716**. The channels between STP handler **712**, CCM handler **715**, and supervisor **712** carry supervisory and administrative information. The channel between STP handler **712** and CCM handler **716** carries ISUP message information.

Platform handler **710** accepts, disassembles, and buffers ISUP messages received from the network. It can perform basic checks on the messages before transferring them to the message handler. Should more than one message handler be connected to platform handler **710**, the ISUP messages could be allocated to the message handlers based on the SLS of the particular ISUP message. CCM handler **716** accepts routing instructions from the message handler for routing certain ISUP messages to select processes of the message handler. Platform handler **710** also provides supervision and a man/machine interface for the CCM.

The Message Handler.

FIG. **8** depicts a version of the message handler. Message handler **820** is shown and includes call center **821**, origination manager **822**, termination manager **823**, detection point manager **828**, feature manager **824**, auxiliary manager **825**, switching manager **826**, and local resource **827**. A primary function of message handler **820** is to process ISUP messages.

Call center **821** is the process which receives call set-up messages from the platform handler. ISUP call set-up is initiated with the LAM. When call center **821** receives an IAM, it creates an instance of an origination manager process with data defined by the information in the IAM. Origination manager **822** represents any of the origination manager processes spawned by call center **821**. The CCM handler is instructed of the new instance so that subsequent ISUP messages related to that call can be transferred directly to the appropriate instance of origination manager **822** by the platform handler.

Origination manager **822** sets up a memory block called an originating call control block. The call control block provides a repository for information specific to a call. For example, the originating call control block could identify the following: the call control block, the origination manager, the message handler, the originating LEC, the LEC trunk circuit (CIC), the ATM virtual circuit, the ATM virtual path, the caller's number, the dialed number, the translated dialed number, the originating line information, the ANI service class, the selected route, the number of the selected route, the SLS, the OPC, the DPC, the service indicator (SIO), echo cancellation status, reason of release, call status, and pointers to adjacent call control blocks. In addition, the call control block would also contain the various times that signaling messages are received, such the address complete message (ACM), the answer message (ANM), the suspend message (SUS), the resume message (RES), and the release message (REL). Those skilled in the art would be aware of other pertinent data to include.

Origination manager **822** executes call processing in accordance with the Basic Call State Model (BCSM) recommended by the International Telecommunications Union (ITU), but with some notable exceptions. Origination manager **822** processes the IAM through each point in call (PIC) until a detection point (DP) is encountered. When a detection point is encountered, a message is sent to detection point manager **828** and processing is suspended at origination manager **822** until detection point manager **828** responds. An example of a detection point for origination manager **822** would be to authorize an origination attempt.

Detection point manager **828** accepts messages from originating manager **822** caused by a detection point encountered during call processing. Detection point manager **828** will identify whether or not the detection point is armed. An armed detection point has specific criteria which can affect call processing if met. If the detection point is not armed, detection point manager **828** will send a continue signal back to origination manager **822**. A continue message instructs origination manager **822** to continue call processing to the next detection point. If the detection point is armed, detection point manager **828** will take action to see if the detection point criteria are met. If detection point manager **828** requires assistance to process the armed detection point, it will send a message to feature manager **824**.

Feature manager **824** would accept messages from detection point manager **828** and either forward the a message to auxiliary manager **825** or to switching manager **826**. Particular feature messages would be routed to auxiliary manager **825** which will process these call features. These are typically non-IN features, such as echo control or POTS billing. Other feature messages would be routed to switching manager **826**. These are typically IN features. Examples of IN features are **800** number translation or a terminal mobility number translation. Feature manager **824** will pass information back to detection point manager **828** (then to origination manager **822**) when it is received back from auxiliary manager **825** or switching manager **826**.

Switching manager **826** which will determine if the request will be handled by local resource **827** or by the data handler. Local resource **827** will be structured to provide data more efficiently stored at message handler **820**. Examples of such data include: an automatic number identification (ANI) validation table which checks the caller's number, a dialed number translation table to translate POTS

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numbers into a routing instructions, or N00 translation tables to translate select **800** numbers into routing instructions. Examples of a routing instruction yielded by the tables would be a particular access connection or a virtual connection. An example of data in the data handler would be virtual private network (VPN) routing tables or complex **800** routing plans.

Typically, originating manager **822** will execute through the pertinent points in call to a point indicating that set up is authorized. At this point, origination manager **822** will instruct call center **821** to create an instance of a termination manager. Termination manager **823** represents any of these termination managers. Origination manager **822** will also transfer IAM information to termination manager **823**. Termination manager **823** sets up a memory block called a terminating call control block. The call control block provides a repository for information specific to a call and is similar in composition to the originating call control block.

Termination manager **823** also operates in accord with the BCSM of the ITU, but also with some exceptions. Termination manager **823** continues processing for the call through its own points in call until detection points are encountered. When a detection point is encountered, a message is sent to detection point manager **828** and processing is suspended at termination manager **823** until detection point manager **828** responds. An example of detection point for termination manager **822** would be to authorize termination which would entail authorizing the call as set-up by origination manager **822**. Messages from termination manager **823** to detection point manager **828** are handled as discussed above for messages from originating manager **822**. When processing by termination manager **823** is complete, it will produce a signaling message to transmit through platform handler **410** to the appropriate multiplexers, and possibly to the users.

Message handler **820** communicates with the data handler using a data transfer protocol. Examples include UDP/IP, or the Intelligent Network Applications Protocol (INAP) which is contained within the component sublayer of Transaction Capabilities Application Part (TCAP).

The Data Handler

FIG. **9** shows a version of the data handler. Data handler **930** is shown. Data handler **930** includes service control center **931**, service selection **932**, service logic center **933**, feature process **934**, service data center **935**, service data manager **936**, echo control **937**, and accounting **938**. Data handler **930** receives service request messages from the message handler. These messages result from an armed detection points triggering the message handler to invoke data handler **930**. The messages also result from features implemented through the auxiliary manager. Service control center **931**, service logic center **933**, and service data center **935** are static processes created at start-up. Service control center **931** creates instances of service selection managers on a call by call basis. Service control center **931** notifies the Switching manager to route subsequent service request messages for that call to the appropriate service selection manager. Service selection manager **932** represents any of the service selection managers created by service control center **931**.

Service selection manager **932** executes the service portion of the call processing. Service selection manager **932** identifies the various services associated with each message and implements the service through messages to service logic center **933**. Service logic center **933** accepts messages from service selection **932** and creates instances of the feature processes required for the identified services. Examples of feature processes are **N00**, messaging, personal/terminal mobility, and virtual private network (VPN). Feature processes are service logic programs which implement the required services for a call. Feature process **934** represents any of the feature processes created by service logic center **933**. Feature process **934** accesses the network resources and data required to implement the service. This would entail executing service independent blocks (SIBs). A SIB is a set of functions. An example of a function would be to retrieve the called number from a signaling message. SIBs are combined to build a service. An example of a SIB is translating a called number.

Those skilled in the art are familiar with the above services, although they have never been implemented by a system such as the present invention. **N00** services are services such as 800, 900, or 500 calling in which the dialed number is used to access call processing and billing logic defined by the subscriber to the service. Messaging entails connecting the caller to a voice messaging service. For example, the receipt of a release message (REL) with a cause of busy could be a trigger recognized by the message handler. In response, the data handler would create an instance of the messaging feature process and determined if a call placed to a particular dialed number would require the voice messaging platform. If so, the CCM would instruct an SSP to connect the caller to the voice message platform. Personal/Terminal mobility includes recognizing that the dialed number has mobility that requires a database look-up to determine the current number. The database is updated when the called party changes locations. VPN is a private dialing plan. It is used for calls from particular dedicated lines, from particular calling numbers (ANIs), or to particular dialed numbers. Calls are routed as defined for the particular plan.

In the execution of the SIB to provide the service, feature process **934** would invoke service data center **935** to create an instance of service data manager **936**. Service data manager **936** accesses the network databases that provide the data required for the service. Access could be facilitated by TCAP messaging to an SCP. Service data manager **936** represents any of the service managers created by service data center **935**. Once the data is retrieved, it is transferred back down to feature process **934** for further service implementation. When the feature processes for a call finish execution, service information is passed back down to the message handler and ultimately to the origination or termination manager for the call.

After a release message on a call, billing requests will be forwarded to accounting **938**. Accounting **938** will use the call control block to create a billing record. The call control block would contain information from the ISUP messages for the call and from CCM processing. From the address complete message (ACM), the call control block would include the routing label, CIC, message type, and cause indicators. From the answer message (ANM), the call control block would include the routing label, CIC, message type, and backward call indicators. From the initial address message (IAM), the call control block would include the routing label, CIC, message type, forward call indicators, user service information, called party number, calling party number, carrier identification, carrier selection information, charge number, generic address, origination line information, original called number, and redirecting number. From the release message (REL), the call control block would include the routing label, CIC, message type, and

cause indicators. From the suspend message (SUS) or the pass along message (PAM), the call control block would include the routing label, CIC, and message type. Those skilled in the art are familiar with other pertinent information for a billing record and appreciate that some of this information could be deleted.

For POTS calls, the billing request will come from the origination and termination managers through the auxiliary manager. For IN calls, the request will come from service selection **932**. Accounting **938** will generate a billing record from the call control blocks. The billing record will be forwarded to a billing system over a billing interface. An example of such an interface is the I.E.E.E. **802.3** FTAM protocol.

At some point during call set-up, the origination manager, termination manager or even the detection point process will check the user service information data and originating line information to assess the need for echo control. If the call is a data call, a message is sent to data handler **930**. Specifically, the message is routed through the auxiliary manager to the echo control manager **937** in data handler **930**. Based on the CIC, echo control manager **937** can select which echo canceller and DS**0** circuit needs to be disabled. A message will be generated to that effect and transmitted over a standard data link to the pertinent echo canceller or echo control system. As described above, echo control can be implemented by the multiplexer. Once a release (REL) message is received for the call, the echo canceller is re-enabled. On a typical call, this procedure will occur twice. Once for an echo canceller on the access side, and again for an echo canceller on the terminating side. The CCM that handles the IAM for a particular call segment will control the particular echo cancellers for the segment.

IAM Call Processing

Prior to a description of IAM processing, a brief description of SS7 message is given. SS7 messaging is well known in the art. SS7 ISUP messages contain numerous fields of information. Each message will have a routing label containing a destination point code (DPC), an origination point code (OPC), and a signaling link selection (SLS) which are used primarily for routing the message. Each message contains a circuit identification code (CIC) which identifies the circuit to which the message relates. Each message contains the message type which is used to recognize the message. ISUP messages also contain mandatory parts filled with fixed length data and variable length data, in addition to a part available for optional data. These parts vary from message type to message type depending on the information needed.

The initial address message (IAM) initiates the call and contains call set-up information, such as the dialed number. IAMs are transferred in the calling direction to set up the call. During this process, TCAP messages may be sent to access remote data and processing. When the IAMs have reached the final network element, an address complete message (ACM) is sent in the backward direction to indicate that the required information is available and the called party can be alerted. If the called party answers, an answer message (ANM) is sent in the backward direction indicating that the call/connection will be used. If the calling party hangs up, a release message (REL) is sent to indicate the connection is not being used and can be torn down. If the called party hangs up, a suspend message (SUS) is sent and if the called party reconnects, a resume (RES) message keeps the line open, but if their is no re-connection, a release message (REL) is sent. When the connections are free, release complete messages (RLC) are sent to indicate that the connection can be re-used for another call. Those skilled in the art are aware of other ISUP messages, however, these are the primary ones to be considered. As can be seen, the IAM is the message that sets-up the call.

In the preferred embodiment, call processing deviates from the basic call model recommended by the ITU, although strict adherence to the model could be achieved in other embodiments. FIGS. **10–12** depicts the preferred call processing. Referring first to FIG. **10**, When the IAM for a call is received at **1005**, the call center creates an instance of an origination manager at **1010**.

The origination manager begins call processing by sending an authorize message to the detection point manager. Detection point manager checks IAM information, including the dialed number, the CIC, and the originating line information, to perform service discrimination at **1015**. This is done to determine if the service requested requires validation at **1020**. Current call processing systems and the BCSM of the ITU both validate the call before performing service discrimination. In a significant advance over the prior art, the preferred embodiment deviates from known call processing methods by looking at the IAM information prior to validation to determine if validation is even required. For example, the calling party may not pay the bill for a call. The called party pays the bill on 800 calls and validation can be unnecessary. If validation is not required at **1020**, call processing proceeds directly to B. Advantageously, this avoids unnecessary look-ups in validation tables for a significant percentage of calls.

If validation is required at **1020**, a validation table is checked at **1025**. Validation checks to see if a call should be allowed and focuses on potential billing problems for the call. For example, calls from ANIs that are delinquent on payments pose problems for billing and may not be validated. Validation would entail messaging from the detection point manager through the feature manager and the switching manager to the local resource to access the tables. The table may list authorized ANIs, unauthorized ANIs, or both. If the call is not authorized at **1030**, treatment (i.e. route to an operator or message) is given to the call at **1035**.

If the call is authorized at **1030**, the services identified at **1015** are checked at **1040** to determine if the call can be routed. This would typically occur for POTS calls. If no additional services are required at **1040**, the dialed number is translated into a route instruction at **1045**. The route instruction could be a particular virtual connection and/or access connections. The processing then proceeds to A. If additional services are required at **1040**, processing proceeds to B.

FIG. **11** picks up processing at B after a route has been selected. A termination manager is created at **1105**. The termination manager is responsible for processing in accordance with the terminating BCSM of the ITU. However, in some embodiments, the processing can exhibit some deviation. For example, detection points such as select facility and validate call may be skipped.

The bearer capability is analyzed at **1110** to determine if the call is a data call at **1115**. This analysis could occur elsewhere in the call processing (i.e by the origination manager after the route is selected.) If a data call is found at **1115**, an echo control message is sent to the data handler at **1120**. Echo control instructions are created at **1125**. The echo control instructions identify the connection for the call which requires echo control. The message could be sent to

the echo control system over a conventional data link from the CCM to the echo control system. If, the echo control is implemented in the multiplexers, the echo control message could be included with the route instruction message.

If the call is not a data call at **1115** or after echo control processing at **1125**, a signaling message is created at **1135**. The new signaling message identifies the access connections and virtual connection for the call. The new signaling message can also contain echo control instructions. The new signaling message is sent to the platform handler at **1140**.

FIG. **12** picks up the processing at B. At this point, several things are known about the call concerning authorization and service requirements. The call information is then analyzed at **1205** as required to apply services to the call. If the data handler is not required at **1210**, the service is implemented and the route is selected at **1215**. This may occur if a service can be directly implemented by the origination manager or through the local resource. For example, particular **800** translations or dialed number service profiles (i.e call forwarding) can be stored in the local resource. In this case, route selection would be performed by the local resource after the information is analyzed to identify the correct entry to a local resource database. When the local resource is used, the messages must be routed from the detection point processor through the feature manager and switching manager to the local resource.

If the data handler is required for the call at **1210**, a message is sent to the data handler at **1220**. The messaging typically flows from the detection point processor to the feature manager and switching manager to the data handler. Upon receipt of the message at the data handler, the service control center creates an instance of the service selection process at **1225**. The service selection process analyzes the message from the detection point processor and selects the feature processes for the call at **1230**. For example, a call may be placed from a caller in a virtual private network (VPN) to a PCS number. In this case, both a VPN feature process and a PCS feature process would be created.

Each feature process would determine if data was required at **1240**. For example, a personal mobility feature process would need to access a database to locate the called party's current telephone number. If data is required at **1240**, the service data center creates a service data manager at **1245**. The data manager manages the data session and accesses the appropriate database at **1250**. After the data is collected (or none is needed), the service is implemented by the feature process at **1255**. For some features, i.e. **800** service, this may include route selection. The results of the feature process analysis are returned to the origination manager to assimilate. If the feature process does not provide the route, the origination manager must select the route using the local resource or another feature process.

The IAM itself contains numerous fields of information. The following table describes the elements of an IAM with regard to the information content and call processing.

TABLE 1

Initial Address Message

Parameter Field Name	Description
ROUTING LABEL	
Service Indicator	Set a 0101-ISDN user part
Priority	0 or 1 based on destination
Network ID	10 for national network or set based on international trunk group
Destination Point Code	Destination of IAM

TABLE 1-continued

Initial Address Message

Parameter Field Name	Description
Originating Point Code	Origination of IAM
Signaling Link Connection	Link used for messages (same for all messages for the call)
Circuit ID Code	Circuit used for the call between OPC and DPC in the IAM
Message Type	0000 or 0001 for IAM
NATURE OF CONNECTION INDICATORS	
Satellite Indicator	Increment for each satellite used
Continuity Check Indicator	00 -- no check 01 -- set up check and start COT timer 10 -- start timer for COT message.
Echo Suppresser Indicator	Indicates if echo control already implemented or is set if echo control is implemented
FORWARD CALL INDICATORS	
National/International Call Indicator	0 for domestic 1 for international
End to End Method Indicator	Pass any information
Interworking Indicator	Pass any information
IAM Segmentation Indicator	0 for POTS
ISDN User Part Indicator	Pass any information
ISDN Preference Indicator	Pass any information and default to 00
ISDN Access Indicator	Pass any information
SCCP Method Indicator	00
CALLING PARTIES CATEGORY	
Calling Party Category	00000000 for unknown 00001010 for ordinary caller 00001101 for test call
USER SERVICE INFORMATION	
Information Transfer Capability	Pass any information unless destination requires particular settings, but always pass ISDN "unrestricted digital information"
Coding Standard	00
Extension	1
Information Transfer Rate	Pass any information (will be 10000 for POTS)
Transfer Mode	Set at 00 for 64 kbit/sec
Extension	1
User Layer Protocol Identification	Set based on rate adaption, typically 0100010 for user information layer 1
Extension	1 for normal calls 0 for rate adaption
Rate	Nothing for user information layer 1, but 0111 for other rate adaption
Extension	1
CALLED PARTY NUMBER	
Nature of Address Indicator	Identifies the type of call: 0000001 -- original NPA or 950 call 0000011 -- 1+ call 0000100 -- direct dial international call 1110001 -- operator call 1110010 -- operator default 1110011 -- international operator call 1110100 -- long distance operator call 1110101 -- cut through call 1110110 -- 950, hotel/motel, or non equal access call 1110111 -- test call
Odd/Even	number of digits in a called number
Numbering Plan	000 -- default 001 -- for ISDN 101 -- private
Digits Field	number of the called party
ACCESS TRANSPORT	
Access Transport Elements	pass any information

TABLE 1-continued

Initial Address Message

Parameter Field Name	Description
CALLING PARTY NUMBER	
Nature of Address Indicator	indicates the type of calling party address, unique numbers can be used for billing, but the charge number is used for non-unique numbers; 0000000 -- unknown 0000001 -- unique caller number 0000011 -- unique national number 0000100 -- unique international number 1110001 -- non-unique caller number 1110011 -- non-unique national number 1110100 -- non-unique international number 1110111 --test call
Odd/Even	Number of digits in the calling number
Screening	Not applicable
Presentation Allowed/ Restricted	Pass any information for POTS, but restrict for N00 calls that are not allowed
Numbering Plan	000 -- default 001 -- ISDN 101 -- private
Digits Field	Number of the calling party
CARRIER IDENTIFICATION	
Network Identification Plan	Number of digits in identification code for the requested carrier
Type of Network Identification	Identifies the network numbering plan for the call -- 010 for POTS call from LEC
Digit One	First digit in carrier identification code
Digit Two	Second digit in carrier identification code
Digit Three	Third digit in carrier identification code
Digit Four or Null	Fourth digit in carrier identification code (if there are four digits)
CARRIER SELECTION INFORMATION	
Carrier Selection Indicator	Indicates whether the carrier identification code was presubscribed or input
CHARGE NUMBER	
Nature of Address Indicator	This information may be used for billing. 00000001 -- caller number 00000010 -- no ANI, route to operator 00000011 -- caller's national number 00000101 -- route if 800, or route to operator 000011 -- no ANI 00001111 route if 800 or route to operator
Odd/Even	Number of digits in calling number
Numbering Plan	Pass any information
Digits Field	The number of calling party
GENERIC ADDRESS	
Nature of Address Indicator	Pass any information
Odd/Even	Pass any information
Screening	Pass any information
Presentation Allowed/ Restricted	Pass any information
Numbering Plan	Pass any information
Digits Field	Pass any information
ORIGINATING LINE INFORMATION	
Originating Line Information	Identifies particular types of calls, for example: 00000000 -- normal call 00000111 -- call from a restricted phone 00111111 -- call from a cellular roamer
ORIGINAL CALLED NUMBER	
Nature of address Indicator	Pass any information
Odd/Even	Pass any information
Screening	Pass any information
Presentation Allowed/ Restricted	Pass any information
Numbering Plan	Pass any information

TABLE 1-continued

Initial Address Message

Parameter Field Name	Description
Digits Field	Pass any information
REDIRECTING NUMBER	
Nature of Address Indicator	Pass any information
Odd/Even	Pass any information
Screening	Pass any information
Presentation Allowed/ Restricted	Pass any information
Numbering Plan	Pass any information
Digits Field	Pass any information
REDIRECTION INFORMATION	
Redirection Indicator	Pass any information
Original Redirecting Reason	Pass any information
Redirection Counter	Pass any information
Redirection Reason	Pass any information
SERVICE CODE	
Service Code	Pass any information
TRANSIT NETWORK SELECTION	
Network Identification Plan	Identifies the number of digits in the carrier identification code (3 or 4)
Type of Network Identification	Type of network identification for transit network parameter
Digits 1, 2, 3, 4	Carrier identification code of the international transit carrier
Circuit Code	Indicates how the call was dialed: 0001 -- international call no operator requested 0010 -- international call, operator requested
HOP COUNTER	
Hop Counter	limits the number of times an IAM may transfer through a signaling point. If the count reaches the limit, release the call

Subsequent ISUP Message Processing

The processing of the IAM is discussed above. Those skilled in the art are will appreciate how other SS7 messages can be incorporated into the processing of the present invention. For example, the time an address complete message (ACM) is received is recorded in the call control block for billing and maintenance. Triggers can also be based on receipt of subsequent messages, such as the ACM. The process for the answer message (ANM) is much the same.

Cut-through is the time point at which the users are able to pass information along the call connection from end to end. Messages from the CCM to the appropriate network elements are required to allow for cut-through of the call. Typically, call connections include both a transmit path from the caller and a receive path to the caller, and cut through is allowed on the receive path after the ACM is received and on the transmit path after the ANM is received.

Upon receipt of a release (REL) message, the CCM will write a time for the message to the call control block and check for triggers upon release (such as call re-originate). Additionally, any disabled echo canceller will be re-enabled, and the call control block will be used to create a billing record. Upon the receipt of a release complete message (RLC), the CCM will transmit messages directing tear down of the call path. It will clear its call specific processes and reuse the call connections for subsequent calls.

Additionally, suspend messages (SUS) and pass along messages (PAM) may be processed by the CCM. A suspend

message (SUS) indicates that the called party has disconnected and a REL will follow if the called party does not re-connect with a specified time. A PAM is simply a message between signaling points and can contain a variety of information and be used for a variety of purposes.

The invention allows switching over an ATM fabric on a call by call basis. This allows efficient high capacity virtual connections to be exploited. Advantageously, the invention does not require signaling capability in an ATM switch. The invention does not require call processing capability in an ATM switch. This enables networks to implement ATM switching without these sophisticated ATM switches that support high volumes of calls. It also avoids the cost of these switches. The invention fully supports voice traffic and non-voice traffic. The invention supports services, such as NOO, VPN, personal/terminal mobility, and voice messaging without requiring the service capability in an ATM switch. Relying on ATM cross-connects is advantageous because ATM cross-connects are farther advanced than ATM switches, and the cross-connects require less administrative support.

Those skilled in the art will appreciate that variations from the specific embodiments disclosed above are contemplated by the invention. The invention should not be restricted to the above embodiments, but should be measured by the following claims.

I claim:

1. A communication method for a call comprising:

receiving set-up signaling associated with the call into a processing system;

processing the set-up signaling in the processing system to select a DS**0** connection;

generating a message identifying the DS**0** connection;

transmitting the message from the processing system;

receiving the message and an asynchronous communication associated with the call into an interworking unit;

in the interworking unit, converting the asynchronous communication into a user communication; and

transferring the user communication from the interworking unit to the DS**0** connection in response to the message.

2. The method of claim **1** wherein transferring the user communication comprises transferring a voice communication.

3. The method of claim **1** wherein processing the set-up signaling in the processing system to select the connection comprises processing the set-up signaling in the processing system to select a trunk group.

4. The method of claim **1** wherein receiving the asynchronous communication comprises converting the asynchronous communication from an optical signal to an electrical signal.

5. The method of claim **1** wherein transferring the user communication comprises converting the user communication from an electrical signal to an optical signal.

6. The method of claim **1** wherein the asynchronous communication is in asynchronous transfer mode.

7. The method of claim **1** wherein the processing system is external to telecommunication switches.

8. The method of claim **1** wherein receiving and processing the set-up signaling to select the connection comprises receiving and processing an initial address message to select the connection.

9. The method of claim **1** wherein receiving and processing the set-up signaling to select the connection comprises receiving and processing a called number to select the connection.

10. The method of claim **1** wherein receiving and processing the set-up signaling to select the connection comprises receiving and processing a caller number to select the connection.

11. The method of claim **1** wherein processing the set-up signaling in the processing system to select the connection comprises accessing a service control point.

12. The method of claim **1** wherein processing the set-up signaling in the processing system to select the connection comprises executing a Call Control Function (CCF) and a Service Switching Function (SSF).

13. The method of claim **1** wherein processing the set-up signaling in th e processing system to select the connection comprises accessing a remote node that executes a Service Control Function (SCF).

14. The method of claim **1** wherein processing the set-up signaling in the processing system to select the connection comprises validating a call.

15. The method of claim **1** wherein processing the set-up signaling in the processing system to select the connection comprises screening a call.

16. The method of claim **1** wherein processing the set-up signaling in the processing system to select the connection comprises routing a call.

17. The method of claim **1** wherein processing the set-up signaling in the processing system to select the connection comprises processing the set-up signaling for an N00 service.

18. The method of claim **1** wherein processing the set-up signaling in the processing system to select the connection comprises processing the set-up signaling for a mobility service.

19. The method of claim **1** wherein processing the set-up signaling in the processing system to select the connection comprises processing the set-up signaling for a virtual network service.

20. The method of claim **1** wherein processing the set-up signaling in the processing system to select the connection comprises processing the set-up signaling for a voice messaging service.

21. The method of claim **1** wherein processing the set-up signaling in the processing system to select the connection comprises selecting the connection based on a translation of a called number.

22. The method of claim **1** wherein processing the set-up signaling in the processing system to select the connection comprises selecting the connection based on network loads.

23. The method of claim **1** wherein processing the set-up signaling in the processing system to select the connection comprises selecting the connection based on destination conditions.

24. The method of claim **1** further comprising storing data for the user communication identifying an originating carrier, originating circuit, the connection, caller number, called number, originating line set-up signaling, and echo cancellation status.

25. The method of claim **1** further comprising storing data for the communication identifying receipt times for an answer message and a release message.

26. The method of claim **1** further comprising processing the set-up signaling in the processing system to generate an initial address message.

27. The method of claim **1** further comprising:

processing the set-up signaling in the processing system to generate an echo cancellation instruction;

transmitting the echo cancellation instruction from the processing system;

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receiving the echo cancellation instruction into the interworking unit; and

in the interworking unit, canceling echo from the asynchronous communication in response to the echo cancellation instruction.

28. The method of claim **1** further comprising:

processing the set-up signaling in the processing system to generate an encryption instruction;

transmitting the encryption instruction from the processing system;

receiving the encryption instruction into the interworking unit; and

in the interworking unit, decrypting the asynchronous communication in response to the encryption instruction.

29. The method of claim **1** further comprising:

processing the set-up signaling in the processing system to generate a compression instruction;

transmitting the compression instruction from the processing system;

receiving the compression instruction into the interworking unit; and

in the interworking unit, decompressing the asynchronous communication in response to the compression instruction.

30. The method of claim **1** further comprising:

processing the set-up signaling in the processing system to generate a decibel level instruction;

transmitting the decibel level instruction from the processing system;

receiving the decibel level instruction into the interworking unit; and

in the interworking unit, adjusting a decibel level of the user communication in response to the decibel level instruction.

31. The method of claim **1** further comprising:

processing the set-up signaling in the processing system to generate a DTMF tone detection instruction;

transmitting the DTMF tone detection instruction from the processing system;

receiving the DTMF tone detection instruction into the interworking unit; and

in the interworking unit, detecting a DTMF tone from the asynchronous communication in response to the DTMF tone detection instruction.

32. The method of claim **1** further comprising:

processing the set-up signaling in the processing system to generate a message instruction;

transmitting the message instruction from the processing system;

receiving the message instruction into the interworking unit; and

in the interworking unit, playing a message in response to the message instruction.

33. The method of claim **1** further comprising:

receiving and processing an answer message in the processing system to generate a cut-through instruction;

transmitting the cut-through instruction from the processing system;

receiving the cut-through instruction into the interworking unit; and

in the interworking unit, cutting-through the call in response to the cut-through instruction.

34. The method of claim **1** further comprising:

receiving and processing a release message in the processing system to generate a termination instruction;

transmitting the termination instruction from the processing system;

receiving the termination instruction into the interworking unit; and

in the interworking unit, terminating the call in response to the termination instruction.

35. A communication system for a call comprising:

a processing system configured to receive set-up signaling associated with the call, process the set-up signaling to select a DS**0** connection, generate a message identifying the DS**0** connection, and transfer the message; and

an interworking unit configured to receive the message and an asynchronous communication for the call, convert the asynchronous communication into a user communication, and transfer the user communication to the DS**0** connection in response to the message.

36. The communication system of claim **35** wherein the user communication comprises a voice communication.

37. The communication system of claim **35** wherein the processing system is configured to process the set-up signaling to select a trunk group.

38. The communication system of claim **35** wherein the interworking unit is configured to convert the user communication from an electrical signal to an optical signal.

39. The communication system of claim **35** wherein the interworking unit is configured to convert the asynchronous communication from an optical signal to electrical an signal.

40. The communication system of claim **35** wherein the asynchronous communication is in asynchronous transfer mode.

41. The communication system of claim **35** wherein the processing system is external to telecommunication switches.

42. The communication system of claim **35** wherein the set-up signaling comprises an initial address message.

43. The communication system of claim **35** wherein the processing system is configured to process a called number in the set-up signaling to select the connection.

44. The communication system of claim **35** wherein the processing system is configured to process a caller number in the set-up signaling to select the connection.

45. The communication system of claim **35** wherein the processing system is configured to access a service control point to select the connection.

46. The communication system of claim **35** wherein the processing system is configured to execute a Call Control Function (CCF) and a Service Switching Function (SSF).

47. The communication system of claim **35** wherein the processing system is configured to access a remote node that executes a Service Control Function (SCF).

48. The communication system of claim **35** wherein the processing system is configured to process the set-up signaling to validate a call.

49. The communication system of claim **35** wherein the processing system is configured to process the set-up signaling to screen a call.

50. The communication system of claim **35** wherein the processing system is configured to process the set-up signaling to route a call.

51. The communication system of claim **35** wherein the processing system is configured to process the set-up signaling for an N00 service.

52. The communication system of claim **35** wherein the processing system is configured to process the set-up signaling for a mobility service.

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53. The communication system of claim **35** wherein the processing system is configured to process the set-up signaling for a virtual network service.

54. The communication system of claim **35** wherein the processing system is configured to process the set-up signaling for a voice messaging service.

55. The communication system of claim **35** wherein the processing system is configured to process the set-up signaling to select the connection based on a translation of a called number.

56. The communication system of claim **35** wherein the processing system is configured to process the set-up signaling to select the connection based on network loads.

57. The communication system of claim **35** wherein the processing system is configured to process the set-up signaling to select the connection based on destination conditions.

58. The communication system of claim **35** wherein the processing system is configured to store data for the communication identifying an originating carrier, originating circuit, the connection, caller number, called number, originating line set-up signaling, and echo cancellation status.

59. The communication system of claim **35** wherein the processing system is configured to store data for the communication identifying receipt times for an answer message and a release message.

60. The communication system of claim **35** wherein the processing system is configured to process the set-up signaling to generate an initial address message.

61. The communication system of claim **35** wherein:

the processing system is configured to process the set-up signaling to generate and transmit an echo cancellation instruction; and

the interworking unit is configured to receive the echo cancellation instruction and cancel echo from the asynchronous communication in response to the echo cancellation instruction.

62. The communication system of claim **35** wherein:

the processing system is configured to process the set-up signaling to generate and transmit an encryption instruction; and

the interworking unit is configured to receive the encryption instruction and decrypt the asynchronous communication in response to the encryption instruction.

63. The communication system of claim **35** wherein:

the processing system is configured to process the set-up signaling to generate and transmit a compression instruction; and

the interworking unit is configured to receive the compression instruction and decompress the asynchronous communication in response to the compression instruction.

64. The communication system of claim **35** wherein:

the processing system is configured to process the set-up signaling to generate and transmit a decibel level instruction; and

the interworking unit is configured to receive the decibel level instruction and adjust a decibel level in the user communication in response to the decibel level instruction.

65. The communication system of claim **35** wherein:

the processing system is configured to process the set-up signaling to generate and transmit a DTMF tone detection instruction; and

the interworking unit is configured to receive the DTMF tone detection instruction and detect a DTMF tone in the asynchronous communication in response to the DTMF tone detection instruction.

66. The communication system of claim **35** wherein:

the processing system is configured to process the set-up signaling to generate and transmit a message instruction; and

the interworking unit is configured to receive the message instruction and play a message in response to the message instruction.

67. The communication system of claim **35** wherein:

the processing system is configured to receive and process an answer message to generate and transmit a cut-through instruction; and

the interworking unit is configured to receive the cut-through instruction and cut-through the call in response to the cut-through instruction.

68. The communication system of claim **35** wherein:

the processing system is configured to receive and process a release message to generate and transmit a termination instruction; and

the interworking unit is configured to receive the termination instruction and terminate the call in response to the termination.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 6,298,064 B1
DATED : October 2, 2001
INVENTOR(S) : Joseph Michael Chrisite

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

Title page,
Item [63], **Related U.S. Application Data**, replace "Continuation of application No. 09/353,401, filed on Jul. 15, 1999, which is a continuation of application No. 08/525,897, filed on Sep. 8, 1995, now Pat. No. 5,991,301, which is a continuation-in-part of application No. 08/568,551, filed on Dec. 7, 1995, now Pat. No. 5,825,780, which is a continuation of application No. 08/238,605, filed on May 5, 1994, now abandoned."
with -- Continuation of application No. 09/353,401, filed on July 15, 1999, now Pat. No. 6,473,429, which is a continuation of application No. 08/525,897, filed on Sep. 8, 1995, now Pat. No. 5,991,301, which is a continuation-in-part of application No. 08/238,605, filed on May 5. 1994, now abandoned. --

Signed and Sealed this

Twenty-seventh Day of January, 2004

Jon W. Dudas

JON W. DUDAS
Acting Director of the United States Patent and Trademark Office

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 6,298,064 B1 Page 1 of 1
DATED : October 2, 2001
INVENTOR(S) : Joseph Michael Christie

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

Title page,
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-- Continuation of application No. 09/353,401, filed on Jul. 15, 1999, now Pat. No. 6,473,429, which is a continuation of application No. 08/525,897, filed on Sep. 8, 1995, now Pat. No. 5,991,301. --

Signed and Sealed this

Eighteenth Day of January, 2005

Jon W. Dudas

JON W. DUDAS
Director of the United States Patent and Trademark Office